ENLARGEMENT OF THE PROSTATE

DEAVER

Median Sagittal Section of the Pelvis and the Lower Abdomen, Showing the General Relations of the Prostate to the Bladder, the Urethra, and the Rectum.

ENLARGEMENT OF THE PROSTATE

ITS HISTORY, ANATOMY, ETIOLOGY, PATHOLOGY, CLINICAL CAUSES SYMPTOMS, DIAGNOSIS, PROGNOSIS, TREATMENT; TECHNIQÜE OF OPERATIONS, AND AFTER-TREATMENT

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SECOND EDITION

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TO THE MEMORY OF

J. B. D., Jr.

WHO DEPARTED THIS LIFE AT THE THRESHOLD OF MANHOOD, AND WHO I HAD HOPED WOULD TRAVEL IN MY FOOTSTEPS

THIS BOOK IS AFFECTIONATELY DEDICATED

PREFACE TO THE SECOND EDITION

Since the appearance of the first edition of this book, the surgery of prostatic obstruction has been perfected to a remarkable degree. The underlying principles of prostatectomy however, have not changed materially.

It is an impressive fact that the operation, which, we advised in the previous edition, should be performed "only after all palliative means had been tried without success," is now justifiable as a primary procedure, and one far safer in the average case than any form of palliation. This radical change in point of view is dependant upon factors other than the mere technical problems involved, and it was with this thought in mind that the present revision was made.

The reader who desires to learn the technique of prostatectomy will find ample descriptions of the various methods employed; he will find, moreover, a practical discussion of the preoperative and postoperative methods of treatment.

It has been our aim to make the book essentially practical, therefore, we have omitted in large part, theoretical considerations, and for the same reason, have preferred to omit many proposed refinements in technique, which are, in our opinion, of minor value. Further, we have confined our descriptions to those laboratory tests which have proved personally satisfactory in our daily work.

The chapter on diagnosis has been fully revised and a section on the use of the cystoscope in prostatic hypertrophy added. The section on embryology has been rewritten and the physiological problems related to prostatic enlargement are dealt with in a separate chapter. In the present edition the question of prognosis is discussed at considerable length, our conclusions being based on the study of a large series of collected cases. Herein is shown the comparative importance of the various phases of treatment, the overwhelming importance of painstaking preoperative treatment, and the comparative mortality and morbidity rates with the different operative techniques. Comparison is made between the operative mortality, as reported by recognized leaders in prostatic surgery, with that obtaining at less experienced

hands. A careful survey of the figures presented will promote caution and care in the practice of this important branch of surgery.

The two-stage operation of supra-pubic prostatectomy is fully described and an attempt made to give it a proper place among the various techniques.

If we can impress our readers with the fact that the success of prostatectomy is dependant upon the proper selection and preparation of cases, and can guide them to this attainment, the revision of this book will have been well worth while.

About forty illustrations have been added which with the series of original drawings designed for the former printing serve to elucidate the pathological, clinical and operative phases of the text.

The author again gladly acknowledges his indebtedness to his co-workers in this particular field of study for their kindness in replying to his questionnaire and for other courtesies extended to him.

As on other occasions, Miss. A. M. Jastrow has again rendered valuable assistance in furnishing references and translations from foreign literature, as well as in the preparation of hospital statistics. Grateful acknowledgement is tendered to Dr. A. D. Whiting for the preparation of the index.

PREFACE TO THE FIRST EDITION

The surgery of the prostrate gland has acquired within the last few years such a conspicuous position in both surgical literature and practice, that the publication of another text-book on the subject can scarcely be a matter of surprise. And as the author has had considerable experience, both operative and otherwise, with prostatics, it was not unwillingly that he complied with the request of his publishers to write a monograph on this subject.

In preparing this volume, the aim has been to produce a work fully representative of the subject of which it treats. While the results of the author's own experience have been included, he has taken pains not to remain uninformed of the opinions of other surgeons. A conscientious search and study of prostatic literature has therefore been made, to the end that no personal bias should infect the principles of diagnosis and treatment which it has been endeavoured to inculcate. The present work, therefore, claims to be more than a mere compilation of the ideas of others; the author has not hesitated to hold his own opinions when these have seemed preferable, and he has tried to present the reasons for these opinions in such a way as to command the attention which he thinks they deserve.

The illustrations have been chosen with great care. They are in most cases original, but where it proved impossible to obtain material, selection has been made of those which most nearly presented the requisite characteristics. Although an attempt has been made—and, the author ventures to think, not without success—to illustrate every important phase of prostatic surgery, both pathological and clinical, as well as operative, yet in no instance has a plate been introduced which was not considered illustrative of the text. All the illustrations have been drawn by Mr. C. F. Bauer, except the microscopical plates, which were prepared by Mrs. J. D. Z. Chase, under the direction of Dr. A. O. J. Kelly.

The treatment, other than operative, has been discussed in greater detail than may seem warranted to some; but realizing that this forms by far the largest part of actual practice, it has seemed wise to the author to consider it at length.

In concluding a work which has occupied much of his time for over a year, the author desires to express a hope that the volume will prove of real value to those surgeons and family physicians who have prostatics under their care, and will serve in some little degree to elucidate the principles of surgical treatment of one of the most distressing maladies of mankind.

1634 Walnut Street.

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ENLARGEMENT OF THE PROSTATE

CHAPTER I

HISTORY

It is a remarkable thing that any part of the human body liable to such important pathological changes as the prostate gland should have acquired a conspicuous place in surgery within such comparatively recent years. Its very existence was unknown until the beginning of the sixteenth century, and it is only within the last twenty-five years that its operative surgery has been deemed of sufficient magnitude to require exposition in monographs of any size.

The symptoms of prostatism, if we may believe Sir Everard Home, have been recognized from time immemorial. This ingenious author surmised that the enlargement of the prostate gland met with so universally in old age is "alluded to in the beautiful description of the natural decay of the body, in the Bible, in the book of Ecclesiastes, the 12th chapter, the 6th verse, where it is written, 'or the pitcher be broken at the fountain, or the wheel broken at the cistern,' expressive of the two principal effects of this disease, the involuntary passing of the urine, and the total stoppage."

From scattered observations among the works of the classic authors it appears that these writers considered that patients with prostatic hypertrophy suffered from "excrescences" or "carnosities" at the neck of the bladder; and that when these outgrowths offered obstruction to the evacuation of the bladder, their destruction was attempted with metallic instruments, introduced, of course, through the penile urethra. Certain of the ancient authors recommended incision of the neck of the bladder through the perineum in patients with retention of urine who were "nearly dying with the pain," when the urethra was much inflamed, and therefore impassable to the catheter, even if no calculus existed to serve as an excuse for lithotomy; but it is not known that they actually performed such an operation.

The ignorance of the ancients as to the anatomical existence of the prostate may be explained on the hypothesis that they did not practise

dissection of the human body. According to Galen, Herophilus first employed the term "prostate," which he, however, appears to have applied to the seminal vesicles (ἀδενοειδεῖς προστάται, "prostatæ glandulosæ"), while the term χιρσοειδεῖς προστάται, "prostatæ cirsoides," appears to have represented the ampullæ of the vasa deferentia. It should be recalled, to excuse Herophilus for his apparent confusion of terms, that the prostate gland of the lower domestic animals, as well as that of monkeys, is a bifid organ, much resembling in some cases the human seminal vesicles.

Except for this brief reference, no mention whatever of the prostate gland is to be found until the sixteenth century. Its discovery is attributed to Nicolò Massa, a Venetian physician, who died in 1563. Riolanus, about the middle of the sixteenth century, was the first to suggest that the bladder could be obstructed by a swelling of the prostate. In several cases of urinary retention this surgeon successfully practised incision of the neck of the bladder through the perineum, but it is not recorded whether the cause of the retention was enlargement of the prostate gland.

John Hunter, Sir Everard Home, Brodie and others, both recommended and practised tunneling of the obstructing body by the catheter; but this remedy was finally abandoned as dangerous. Chopart records that when Astruc, ten years before his death, which occurred in 1766, was attacked by retention of urine, his attendant, Lafaye, attempted to introduce a catheter, but met with an obstruction from a tumor in the neck of the bladder. He therefore perforated this with a lance-shaped stylet introduced through the catheter, which was open at the end; and by this means succeeded in forcing the catheter into the bladder and drawing off the urine. The catheter was retained fifteen days. This false passage through the obstructing body persisted, and a catheter was introduced by it as occasion required through the remaining ten years of Astruc's life; and the condition of the parts as described was finally confirmed by the post-mortem examination. Chopart himself tried tunneling of the prostate several times, but with fatal results. Billroth's experience was likewise disastrous in the only case in which he used forced catheterization.

Systematic compression to maintain a patulous urethra was first proposed by Physick, of Philadelphia. His method consisted in the introduction of an elastic hollow tube through the compressed prostatic urethra, as a catheter, and then its distention by fluid pressure. Some success attended this remedy; and it was repeated every two or three

days, the pressure being applied for as long a time as the patient could endure, usually from five to fifteen minutes. Leroy d'Étiolles and Mercier also made use of compression, in an effort to reduce the size of the prostate, or at least to mould it in its growth. Their plan

Fig. 1.—Tunneling the Prostate. A False Passage has been Made in the Dilated Prostatic Urethra.—(*Cruveilhier.*)

consisted in introducing a flexible catheter, and then plunging into it a straight stylet, which forcibly overcame the natural subpubic curve of the urethra. Special instruments were designed for this purpose; but the remedy was so extremely painful in its application that it met with little general favor. The contemporary English surgeons, more-

over, contended, and apparently with an element of truth, that no more was thus accomplished than by passing an ordinary steel sound through the urethra until its curved extremity was wholly within the bladder, when its straight staff would tend to depress the internal orifice of the urethra to its normal position. But probably the best-known advocate of systematic compression was Mr. Reginald Harrison, of London. This surgeon, in 1881, devised special olivary bougies, of gum elastic, from two to four inches longer in the stem than the ordinary instruments, and having an expanded portion an inch

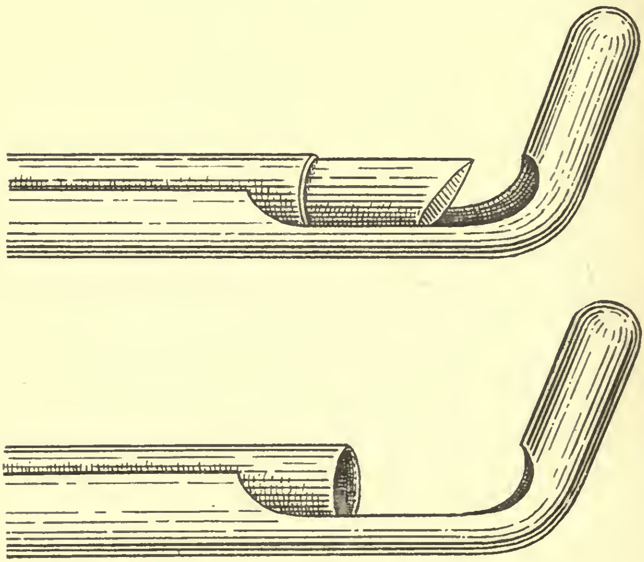

Fig. 2.—Mercier's Prostatotome and Prostatectome.

from the tip, which was made to enter the bladder. By this means the olivary swelling caused dilatation of the urethra and compression of the prostate both as the instrument was introduced into the bladder, and again as it was withdrawn, it being allowed to remain in place for several minutes.

As is the case with every other department of surgery, operative treatment was at first undertaken only in emergency cases, where retention of urine existed; or incidentally as part of another operation, such as lithotomy.

Perineal operations came into favor earlier than those by the suprapubic route, owing probably to the greater familiarity of surgeons with operations in the former region, due to the then widespread

practice of perineal lithotomy. Covillard in 1639 successfully operated by perineal cystotomy, and removed a hard mass, not a stone, crushing and destroying it during extraction with the forceps. This was an isolated case, not undertaken for urinary retention, and does not represent the usual practice at that date. Sir Henry Thompson in referring to this case, asserts that the "hard mass" was a true tumor of the bladder; but Gouley seems to have considered it prostatic.

Chopart describes how Desault, who died in 1795, found and twisted off a tumor in the bladder, after removing a calculus by perineal lithotomy; and Sir William Blizzard several times before 1806 performed perineal prostatotomy for enlargement without any calculous formation. It has been denied by some writers that Sir William Blizzard's operations were anything more than the opening of prostatic abscesses; but he distinctly says that his object in performing such an operation was to reduce the size of the gland by incision, irrespective of the presence of pus, which he says may have been absorbed, only induration remaining.

Perineal prostatotomy combined with lithotomy was by no means infrequent in the early part of the nineteenth century, and was sanctioned by Sir William Fergusson, who employed this procedure before 1848.

Amussat removed a calculus and a protruding mass of the prostate by suprapubic cystotomy before 1832.

But the first regular surgical procedure was established in 1834 by Guthrie, under the name of "division of the bar at the neck of the bladder," this bar in some cases being produced in his opinion by a fold of mucous membrane stretched taut across the vesical orifice of the urethra by symmetrical enlargement of the two lateral lobes of the prostate. He accomplished his purpose by a catheter carrying a concealed blade. Where marked prostatic enlargement coexisted, he advised perineal prostatotomy, but it is not certain that he ever performed it. Mercier, whose name is pre-eminent in the early days of prostatic surgery, devised in 1837 special instruments—called by Gouley "prostatotome" and "prostatectome"—and at later dates modified them in various ways. These instruments resemble the punch devised by Young; the principles governing their use being quite the same. Leroy d'Étiolles as well as Civiale claimed priority over Mercier in the invention of instruments for the operation (urethral prostatotomy) since known by the latter's name; but it appears that their claims are ill founded. Indeed, so occupied were

they with one another's claims that they seem to have at times entirely overlooked the fact that Guthrie was the originator of the method.

A further improvement on Mercier's method was that introduced about 1873 by Bottini, then of Pavia, who aimed to avoid the hemorrhage attendant upon Mercier's operation by the use of a galvano-caustic incisor. Gouley, however, who had considerable personal experience with Mercier's method, which he nevertheless preferred to apply through an external urethrotomy wound, asserted that the bleeding was trifling, and that therefore Bottini's modification was unnecessary. Although the Bottini operation was enthusiastically practised by its originator and a few other Italian surgeons during the twenty years or more following his first description of it, yet it by no means met with general favor until after the publication in 1897 of the well-known paper by Freudenberg, who introduced many improvements in the requisite apparatus. This surgeon, four years later recommended the addition of a centimeter scale to the shaft of the Bottini cautery, in order that the operator might have a more definite idea of the position of the beak of the instrument when in use. Further modifications of the galvano-caustic apparatus were introduced by Dr. H. H. Young, of the Johns Hopkins University, the greatest advantage being that the slipping away of the prostate from the beak of the instrument was rendered nearly impossible, and that thus the risk of burning through the bladder wall instead of through the hypertrophied gland was minimized.

In America Dr. Willy Meyer, of New York, and Dr. Orville Horwitz, of Philadelphia, were among the most prominent advocates of the Bottini method to the practical exclusion of all others.

Belfield in 1886 advocated the employment of Bottini's method through a perineal wound. His advice has been reiterated by Watson (1888), Keyes, Jr. (1902), Wishard, Chetwood (1902); while Watson, (1888), Bangs (1898), and Bouffleur (1902) also recommended the the employment of a cautery through a suprapubic opening. Chetwood's modified galvano-caustic incisor is used by some surgeons at the present time in the treatment of contractures at the vesical neck; this method is described in the chapter devoted to the local palliative treatment of prostatism.

Meanwhile various other methods of treatment had been introduced. Of these, the most important are those that arose from the practice of tapping the bladder in cases of retention of urine where passage of the catheter proved impossible. Simple catheterization to

relieve the bladder of its residual urine had long been employed; Home had even used continuous catheterization—for periods of from one to three months—for the relief of the cystitis. It is interesting to note that the clever maneuver of increasing the curve of the catheter by partially withdrawing the stylet as its beak approached the obstruction was practised and taught by Physick, the Father of American Surgery, long before it was accidentally discovered by Mr. Hey. Dorsey figures in his "Surgery," published in 1818, a catheter with the well-known prostatic curve, which is in this case exaggerated, and, as Dorsey says, is probably as great as will be found necessary in any case of enlargement of the prostate. The instrument known as the "elbowed catheter" of Mercier, originally of silver, and devised by him as a modification of the stone searcher, is now usually made of webbing, and has been found most useful in gaining access to a bladder with prostatic obstruction by the facility with which its point rides over the projection at the vesical orifice of the urethra.

Where it was found impossible to introduce the catheter, the bladder was punctured, either suprapubically or through the rectum. Perineal puncture, though practised during the seventeenth and eighteenth centuries, fell into disuse during the early part of the nineteenth, the rectal being then the favorite route. Suprapubic cystotomy for urinary retention is an operation over three hundred years old, having been advocated by Rossetus in 1590; but it was feared by most surgeons, in the early part of the nineteenth century, that in employing suprapubic puncture there would be great danger of urinary infiltration among the layers of the abdominal wall; and since it was found that in many instances, even after the cannula was withdrawn, the rectal puncture served fairly well for micturition until the urethra again became patulous through the subsidence of inflammation, this was the operation usually adopted. Toward the middle of the last century some surgeons returned to the suprapubic route, while others considered a perineal puncture the only sensible treatment; and rectal puncture was almost wholly cast aside.

From these various procedures arose finally a new method of treatment—that by urinary fistula; and from the concomitant drainage of the bladder it may be considered a distinct advance in therapeusis. Needless to say, some of the patients treated as above described, by puncture of the bladder for retention of urine, developed fistulous tracts which failed to heal. Thus Parrish records that a patient whose bladder had been tapped suprapubically for prostatic retention by Dr.

Wistar (who died in 1818) wore a gold tube in the fistula for two years; at the end of this time normal urination through the penis returned, and the tube was discarded, with the result that death soon followed from a recrudescence of the bladder troubles. This operation had been done, like innumerable others, for prostatic retention where the urethra was impassable; and Sir Henry Thompson narrates that he saw some patients of Mr. Thomas Paget, who had had their bladders punctured suprapubically, completely relieved of the tenesmus and other distressing features by wearing a cannula or a catheter in the suprapubic fistula; and that this sight gave him encouragement to try the effect of permanent drainage even in patients where retention of urine was not complete, and where the urethra was still open to instrumentation. When a suitable case presented itself, he accordingly introduced through the urethra a long curved metal catheter, whose point was closed by a conical obturator; and, making this point impinge upon the wall of the bladder above the pubic symphysis, cut down upon it with a small incision. He then caused the catheter to protrude through the suprapubic wound, withdrew the obturator, passed a cannula like a tracheotomy tube into the point of the catheter, and by withdrawing this latter through the penile urethra, left the suprapubic tube in the bladder. Sir Henry Thompson's observations were first published in 1875, and in many cases in which he employed this method the relief afforded was marked, but he later abandoned this plan of treatment for drainage through the perineum. Dittel, Keyes, and Swinford Edwards were among the other surgeons who at one time or another recommended the suprapubic fistula.

An important improvement in the method of forming the suprapubic fistula was that introduced in 1888 by Hunter McGuire. He formed an artificial urethra in the hypogastric region by establishing a fistulous tract upward from the bladder, so that the fistula "bore the same relation to the bladder that the spout of a coffee pot does to the bowl." By this procedure McGuire was able to completely relieve his patients of their cystitis and residual urine, no involuntary leakage occurring even in the supine position, and the patients in some instances being able to project the stream of urine in a parabolic curve to a distance of several feet by voluntary contraction of the bladder. The urine was retained for from two to six hours. Morris, of New York, in one instance clothed the fistulous tract with skin by transferring narrow cutaneous flaps into the wound at the time of operation. Poncet and Delore have exhaustively studied the subject of supra-

pubic fistula as a means of treatment for patients with enlarged prostate; and the reader is referred to their work for further information. It is interesting to note that Delore collected three cases where patients who had had urachal fistulas in childhood had these open again spontaneously when in old age they developed prostatic retention. A complete review of the literature on urachal fistula will be found in Cullen's book, "The Umbilicus and its Diseases," Philadelphia, 1916.

The treatment by perineal fistula developed as a natural consequence of puncture by the perineum, and from the practice of perineal cystotomy for calculus complicated by enlarged prostate. Besides the mere cystotomy, it was customary to do a prostatotomy, and even a digital divulsion of the obstructing organ. The establishment of a perineal fistula with perineal prostatotomy was a method largely employed by Reginald Harrison, commencing in 1881, his first operation having been performed on November 4th of that year. He used a small perineal incision, opening the membranous urethra; then the prostate was incised; and a metallic perineal tube introduced and retained for from six to twelve weeks. If the natural channel was not eventually restored, the fistula persisted. Prof. Gouley, of New York, claimed priority over Harrison in the re-introduction of perineal prostatotomy, his first operation—in which, however, he left no instrument in the bladder—having been performed April 27, 1880; and his third operation, in which he left a large-sized rubber tube in the perineal wound, having been done in January, 1881. Whitehead and Braun were likewise among the earlier advocates of the treatment by a more or less permanent perineal opening.

Various other methods of treatment, supported by different surgeons, have, at one time or another, claimed the attention of the profession. Heine recommended the injection of iodine into the prostate, and Langenbeck and Iversen the subcutaneous use of ergotine, in the hope of causing a reduction in the size of the gland. The parenchymatous injections were given through the rectum, but in some cases treated by Heine's method it was found that suppuration and even death followed, so that this practice was never very generally employed. Electricity has been employed in these cases, and at times with a certain measure of success; although the cases so reported are open to the criticism of having possibly been merely those of chronic prostatitis, and not of true enlargement. This method has been carefully studied by Chéron and Moreau-Wolf, to whose excellent monograph the reader is referred.

Excision of the obstructing parts of the enlarged prostate by suprapubic cystostomy was first widely advocated by McGill of Leeds, in 1887. Before this date he had practised permanent suprapubic drainage, which he preferred to that by the perineum. Belfield, in America, had done suprapubic prostatectomy before this time, his first operation being in October, 1886; Dittel in 1885 had removed a portion of an obstructing prostate through a previously existing suprapubic fistula, which he enlarged for the purpose; Trendelenburg, in May, 1886, and Benno Schmidt, in August of the same year, had employed this route for removal of pieces of the prostate; but to McGill has always rightly been attributed priority in bringing this procedure prominently before the profession. The most enthusiastic supporters of McGill's operation were Buckstone Brown, Kümmel, Atkinson, Keyes, and Fuller.

As originally practised, this operation consisted in cutting off, through the usual incision of suprapubic cystotomy, by means of scissors, or of rongeur forceps, twisting off with bladder forceps, strangulating with an écraseur or crushing with a lithotrite, any projecting masses of prostatic tissue. It was, however, in time extended so that portions of tissue, forming the so-called prostatic tumors, were enucleated with the finger, either alone, or aided by the scissors or other instrument, from their position deep within the gland.

Many surgeons have labored to prove that Freyer's operation introduced in 1901, is not only surgically, but even anatomically impossible, assailing Mr. Freyer's claim to originality, and asserting that he is laboring under a grave misapprehension if he thinks he is the first person to have operated in this manner; insisting that his method is nothing more than the removal of very large prostatic tumors from the substance of the gland, leaving behind the outer margin of glandular tissue which by the growth of these tumors has been compressed into a thin capsule-like layer. Thus Wallace says: "The more rapidly growing areas (of the diseased prostate) increase at the expense of the more slowly growing ones, which are compressed and stretched over the surface of their quickly growing neighbors. By this process a capsule is formed, ill-defined at first, but later becoming more distinct. The elements forming this capsule show in process of time a lamellar disposition. The adenomatous mass can now be easily enucleated, and not only presents a smooth surface, but also leaves behind a smooth cavity." One "capsule" which he describes, left behind after the post-mortem removal of the prostate, showed within its layers a small lenticular focus of glandular tissue.

He therefore concludes: "These facts . . . seem to leave no reasonable doubt that the so-called total prostatectomy is nothing more than the removal of adenomatous masses." Yet he admits that "if during life the urethra had been sacrificed, and the whole central mass removed, the operator would have been justified in believing that he had removed the entire organ; certainly nothing recognizable as prostate would have been left behind." Taylor entirely concurs in the opinion above expressed by Wallace, to the effect that total enucleation of the prostate gland is an impossible operation; but Roberts, as the result of a careful examination of the structures left after a post-mortem enucleation of the prostate gland by Freyer's method, is of the opinion that the whole gland can be removed during life, since in his experience just alluded to no trace of prostatic tissue could be found remaining behind. The studies of J. W. Thompson Walker confirm the opinion of Roberts.

It seems a pity that so many controversies in regard to surgical priority are so constantly arising, and it appears that prostatic surgery is particularly unfortunate in this respect. Riolanus bitterly denounced his contemporaries for claiming as their own operations which had been employed before their grandfathers were born, and even for a hundred years before that time. Mercier asserted that Civiale and Leroy d'Étiolles had assumed the credit of operations which were not their own, and, with that delightful tendency toward the *argumentum ad hominem* characteristic of the French nationality, added that Leroy had also assumed a name to which he had no right, since in reality Leroy was from Paris, not from Étiolles. Gouley spoke almost venomously against Mr. Harrison; and we think Mr. Freyer would be well able to respond to his critics as Harrison did to Prof. Gouley: "I see that Dr. Gouley claims priority for the proceeding just described; what is of more importance is that it has received his approval."

The fact that we now know that the entire prostate is not removed by Freyer's operation is of very little consequence; who first performed such an operation is of less. To Mr. Freyer is undoubtedly due the credit for bringing prominently before the medical world a plan of operation whereby an attempt is made to remove the entire gland. Some recent writers, among them, Guitéras, claim and apparently on the best of grounds, that Fuller of New York was the first to do a "total" suprapubic prostatectomy. Guitéras states that Fuller "enucleated the lobes in their entirety" for the first time in 1895. As an aid in the enucleation process, Fuller made counter-pressure with the fist in the perineum. At this time Guitéras had the same genito-urinary service

in the City Hospital so that he was in a position to follow the results of Fuller's work very carefully. Guitéras soon saw the advantages of exerting counter-pressure on the prostate with the middle and forefingers introduced into the rectum. This modification of Fuller's operation he described in August, 1900, at the International Medical Congress in Paris. The full text of this paper is reproduced in Guitéras' book on Urology. If the reader is interested in the historical side of prostatic surgery he will profit by reading this interesting account of the operation as it was performed by one of the pioneers in this field of surgery.

Prostatectomy by the perineal route followed close on the practice of perineal prostatotomy, and preceded by a number of years McGill's introduction of the suprapubic method. Employed first for malignant disease (by Küchler in 1866, by Billroth in 1867, by Demarquay in 1873, by Langenbeck in 1876, by Spanton in 1882, and by Leisrink, in 1883), its field of application was soon broadened so as to include benign enlargement. At first, as in the parallel case of the suprapubic operation, portions only of the prostate were removed. Many prominent surgeons have advocated the perineal route, including Harrison (1881), Ashhurst (1882), Annandale (1888), Zuckerkandl (1889), Watson (1889), Dittel (1890), Goodfellow (1891), H. Morris (1895), Ferguson (1901), Syms (1901), Albarran (1901), Petit (1902), Moore (1902), Murphy (1902), Bryson (1902), Young (1903), Senn (1903), and Proust (1903).

The simplest perineal operation is done through a straight median incision. In order to gain more room some surgeons supplemented the median incision by an oblique cut on each side of the anus, making an inverted Y-shaped incision; this method was advocated by Murphy, Baudet, and Senn; while Zuckerkandl advised a transverse semicircular incision, making a flap toward the rectal aspect, this tube being separated from the anterior structures by blunt dissection. A similar though less extensive skin flap is employed by Albarran, Proust, and other French surgeons, as well as by Young, who closely follows their technique. Dittel *aimed to get still more room* by an incision completely encircling the right side of the anus from the coccyx, and continued forward in the median line of the perineum; by this approach he was enabled to remove a wedge-shaped piece of each lateral lobe. The coccyx may be excised if more room is required for completing the operation.

The position used for these variously modified operations differed somewhat: thus, although the usual lithotomy position sufficed for most surgeons, many preferred to have this much exaggerated, while

Proust mounted his patients on a sort of framework, so that the perineum was completely inverted. Dittel employed either the right lateral decubitus, or else had the patient placed on the table in the prone position, with the thighs hanging vertically downward.

These perineal operations all differed in some minor details of technique, as to whether the urethra was opened or not, whether an attempt was made to preserve the ejaculatory ducts, and as to the special instruments employed; some of these matters will be discussed in the last chapters of this book; but for such as appear of purely historical interest the reader must consult the original articles referred to in the appended bibliography.

Combined operations, by the perineal and suprapubic routes, also found a number of supporters. Nicoll (1895) and Alexander (1896) removed the gland through the perineum, aiding its extraction by pushing the prostate down with the fingers of one hand introduced into the bladder through a suprapubic wound. Bryson (1899) and Guitéras (1901) employed a perineal operation in which counterpressure is afforded by the fingers introduced through a suprapubic incision only into the space of Retzius; while another enthusiastic surgeon (Syms), thinking the extraperitoneal opening of an infected bladder too dangerous an operation, proposed freely opening the peritoneal cavity and conducting the manipulations for counterpressure through the unopened bladder-walls, while the prostate is extracted through the perineum. Fuller (1895) did a suprapubic prostatectomy, and then drained by means of a perineal cystostomy, completely closing the suprapubic wound on the removal of its drainage on the fourth day.

Other operators devised special instruments by which to draw the prostate down into the perineal wound without making any suprapubic opening. Murphy employed hooked retractors which grasp the gland from its lower surface; and Syms used a special hollow rubber retractor, introduced into the bladder through a perineal incision in the membranous urethra, the instrument being kept in place by distending its bulbous extremity with water. Proust employed a de Pezzer tractor for the purpose of bringing the prostate downward towards the perineal floor. This instrument has been modified by Young and is now used almost universally by perineal prostatectomists.

A mode of treatment by castration, advocated in 1893 by J. William White, though widely employed by some surgeons for several years, has long since been discarded. White suggested this method in June, 1893; in September of the same year Ramm, of Christiania, published

the results of castration on two patients, on whom he had operated the preceding April. Boeckmann had done a similar operation in May, 1893, and it appears that Tupper, on two occasions, in 1882 and 1886, had performed this operation with the deliberate intention of relieving prostatic troubles, after having seen the effect produced by the removal of the remaining testicle from a patient whose first testicle had been removed for other causes. Ssnitzin, had employed this operation in 1886. Launois, according to Moullin, suggested this form of treatment to Guyon in 1884; and Mr. Moullin himself discussed its advisability with a patient in 1892.

All of these observations were much antedated by those of John Hunter, who, in experimenting on animals, had shown that double castration in young animals prevented the development of the prostate, and that in adult animals it caused the fully developed gland to atrophy and waste away. It had, moreover, been known for many years that in certain animals, such as the mole, which have stated periods for sexual intercourse, the prostate is much diminished in size during the intervals, and hence it was inferred that a continuous abeyance of the sexual function would cause atrophy of the prostate in men. Vasectomy was suggested by Mears as a less severe and mutilating operation. The mortality from castration for enlarged prostate was at least 18 per cent. (White), taking all cases together; and in selected cases was reduced only to about 8 per cent. Griffiths and Mansell Moullin were its chief advocates in Great Britain.

Ligation of both internal iliac arteries to induce ischemic atrophy of the prostate was proposed in 1893 by Bier, and employed by him in three cases, one of the patients, operated on intraperitoneally, dying from septic peritonitis. Of eight patients subsequently operated on intraperitoneally by Bier, two died. Willy Meyer practised this operation in three cases; the first patient recovering, after secondary hemorrhage and partial gangrene of the left foot; but the second died apparently of renal disease, eight days after the operation; while the third was not benefited by his experience. König also reported one patient, operated on by another surgeon, in Chicago, no change in the urinary condition being produced. Of those patients who survived (eleven out of fifteen), eight are said to have had their bladder troubles more or less relieved, while three received no benefit whatever, and four died; a mortality rate of over 26 per cent. Derjuschinsky investigated this method of treatment by conducting experiments upon dogs, and demonstrated that although primary decrease of the size

of the prostate occurred, but at about the end of eight months' time it had regained its original volume by virtue of the establishment of the collateral circulation.

Among the more important of the older monographs which have appeared at various times, treating of diseases of the prostate gland, mention should be made of those by Sir Everard Home (1811), Leroy d'Étiolles (1840), Coulson (1840), Adams (1851), Hodgson (1856), Thompson (1858), Gant (1872), Harrison (1884), Guyon (1888), Rouchaud (1888), Watson (1888), Vignard (1890), Moullin (1894), Poncet and Delore (1899), Freyer (1901), Petit (1902), Socin and Burckhardt (1902), and Proust (1903). A careful study of these works will well repay the efforts of the student who is interested in the history of prostatic surgery; indeed they contain much that will prove of the greatest practical value to the surgeon. In the bibliography will be found references to those authors, contemporaneous and otherwise who have made noteworthy contributions to the literature of prostatic hypertrophy.

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CHAPTER II

EMBRYOLOGY: COMPARATIVE ANATOMY:—GROSS AND MICROSCOPICAL ANATOMY: APPLIED ANATOMY

Embryology.—It will be recalled that the genito-urinary tract is developed from three main sources—the Wolffian bodies and ducts, the Müllerian ducts, and the allantois. This last structure, the earliest of the three to be formed, juts forth in the second week from the primitive gut near its posterior extremity, develops forward and protrudes at the umbilicus, forming a reservoir for waste materials. The allantois in the human embryo is never a free vesicle as it is in the lower mammalian forms. Emerging from the cœlum at the umbilicus it grows into the body stalk, a mesoblastic structure that constitutes a primary and permanent connection between the embryo and the chorion. In the third week the Wolffian bodies appear, one on each side of the body cavity, as a series of tubules, caudal to the region of the heart, and lying approximately at right angles to the Wolffian ducts and in the long axis of the body cavity. The Müllerian ducts, one on each side, appear about the fifth week, and lie parallel to the Wolffian ducts. Both pairs of ducts empty into that portion of the allantois closest to the gut. In the sixth week one can see that the allantois has expanded slightly between its points of departure from the body cavity at the umbilicus and the point at which it receives the two pairs of ducts—the Wolffian and the Müllerian. This expanded part of the allantoic tube forms the future urinary bladder, and growing out from it practically parallel with the two pairs of ducts, is now observed a third pair of tubes, these being the ureters.

The ureters are primarly formed as outgrowths from the Wolffian ducts; they originate from the latter at some distance from their termination so that when these structures are subsequently drawn downward to be included in the expanding urinary tract, the openings of the Wolffian (ejaculatory) ducts occupy a position distal to that of the ureteral openings. The altered position of the allantois into which the Müllerian and Wolffian ducts enter is termed the urogenital sinus. From this the entire female urethra is developed; in the male it gives rise to that portion of the urethra situated between the internal vesical sphincter

and the openings of the ejaculatory ducts. The portion of the male urethra situated distal to the openings of these ducts is formed in conjunction with the penis and is, therefore, primarily separate and distinct from the portion contributed by the urogenital sinus.

As is well known, the Wolffian ducts persist in the male and form the vasa deferentia, while in the female the Müllerian ducts persist, coalescing in their lower portions to form the uterus and the vagina, but in the upper part remaining distinct, and constituting the Fallopian tubes. In the male, although the Müllerian ducts in great part disappear their lower coalesced extremity persists, and is found in the adult as a small diverticulum from the prostatic urethra, known variously as the sinus pocularis, utriculus, uterus masculinus or organ of Weber.

Considerable difference of opinion exists regarding certain phases of the embryological development of the prostate gland, although the studies of Lowsley, and other recent investigators, seem to have cleared up a number of hitherto uncertain steps in the process. It has been the belief of many anatomists that the initial step in the formation of the gland concerns the development of its capsule and the stroma through a process of condensation of the mesoblastic tissue that surrounds the urogenital sinus and the genital cord. This, it has been held, is first discernible in the third month of fetal life when it can be recognized as "an annular mass of mesoblastic tissue that surrounds the lower end of the Wolffian and Müllerian ducts . . . and subsequently becomes differentiated largely into unstriped muscle . . . into this (the condensed mesoblastic tissue), penetrate solid epithelial outgrowths, from the lining of the urethra, which expand into branched cylinders that give rise to the prostatic glandular tissue. These outgrowths are arranged in three groups, a ventral, an upper dorsal, and a lower dorsal. The ventral group gives rise to the glandular tissue in front of the urethra, which at first is relatively abundant, but soon suffers reduction, and in the adult organ is often almost wanting. The dorsal groups produce the important glands of the median and lateral lobes. For a time the latter are arranged as two separate lobes, but afterwards become consolidated by the capsule and broken up by the invasion of the fibro-muscular septum." (Piersol.)

The origin of the musculature of the prostate and of its stroma has been the subject of wide discussion. Most observers have held the view expresssed by Piersol and quoted above, namely that these structures develop from a thickening of the mesoblastic covering of the genital cord—the name given to the connective tissue contain-

ing the Wolffian and the Müllerian ducts. Griffiths, who studied the development of the prostate in considerable detail, taught that no part of the prostate arises from the genital cord. W. G. Richardson, from his more recent studies is of the same opinion. Griffith described the prostatic tubules as invading the muscular fasciculi of the thickened posterior half of the external circular unstriped muscle coat of the urethra in this situation, the invaded portion of the musculature contributing the permanent muscle content of the prostate gland.

Many of the observations recently reported by Lowsley relating to the development of the prostate are at variance with the generally accepted views. The organ, he says, "originates from five groups of tubules which begin as solid epithelial outgrowths and which later develop lumina. These various groups arise from the floor of the urethra between the ejaculatory ducts and the bladder, from each prostatic furrow, from the floor of the urethra outward from the ejaculatory ducts, and from the ventral wall or roof of the urethra, and become the middle right and left lateral, posterior and anterior lobes respectively."

As the prostate develops, certain well-defined changes occur not only in the morphology and structure of the gland, but also in the relation of the orifices of its tubules to the urethral walls. This is already evident in the child at birth, although at no stage of development do the five original groups of tubules lose their identity, as has been well shown by Lowsley who continues in his description as follows: "The tubules grow, with few exceptions, back toward the bladder, and by the sixteenth week are surrounded by developing muscle fibres which in later stages become quite thickly disposed. In early stages the five lobes of the prostate are well separated from one another and later development decreases the separation between the lateral and middle lobes . . . although the independence of these lobes is discernible. The lateral lobes make up the largest portion of the gland. The posterior lobe lies behind the ejaculatory ducts and becomes separated from these and the middle and lateral lobes by a plane of connective tissue. The tubules making up the anterior lobe are at first as large as other tubules and are quite numerous; but at the sixteenth week they are reduced in size, comparatively speaking, and after this time appear to shrink into insignificance. All of the tubules of the prostate seem to be firmly bound together within its capsule, with the exception of those of the middle lobe whose upper ends in some cases seem to extend beyond the capsule, lying freely between the vasa deferentia and the bladder."

Evidently therefore, in the opinion of Lowsley, the glandular portion of the prostate is derived from five sets of tubules, in contradistinction

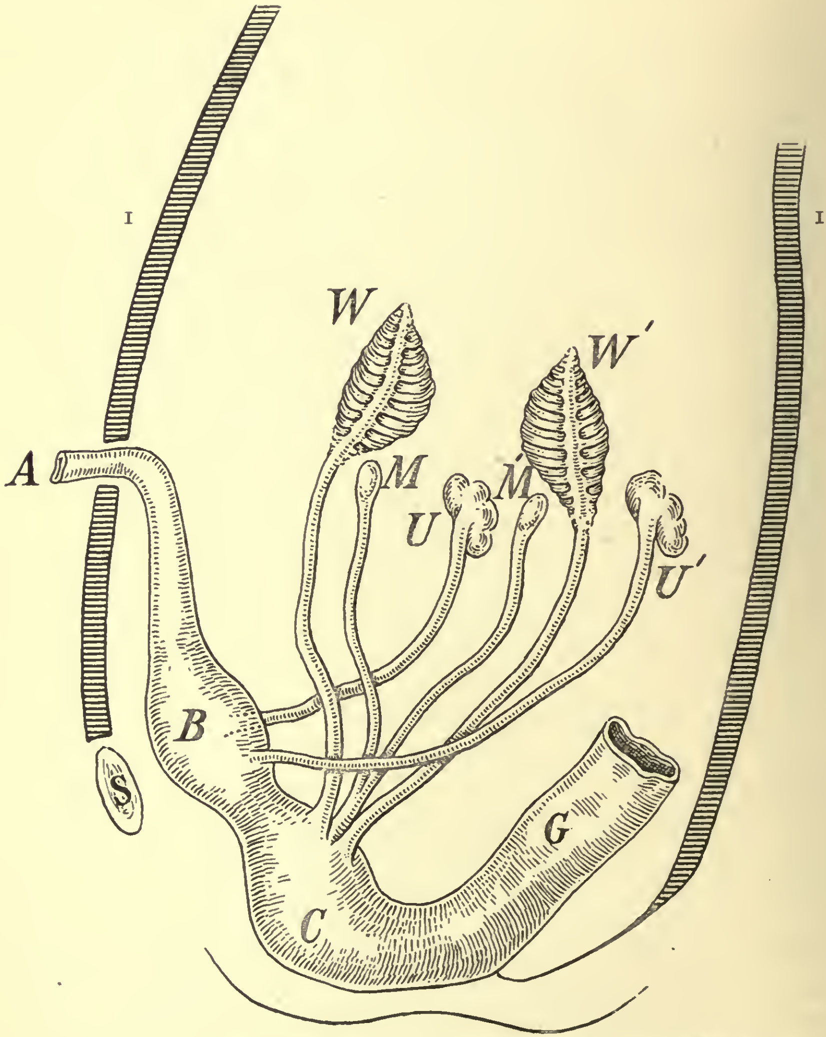

Fig. 3.—Development of the Genito-urinary Tract (Diagrammatic).

1. Body wall. *A*. Allantoic stalk at umbilicus. *B*. Urinary bladder. *C*. Cloaca. *G*. Primitive gut. *S*. Symphysis pubis. *M*, *M'*. Müllerian ducts. *W*, *W*. Wolffian bodies and ducts. *U*, *U'*. Ureters with kidneys attached.

to the views held by Pallin and others that but three groups of tubules are concerned in its development. The former seems to have definitely established the independent origin of the median lobe tubules which have

been looked upon by Pallin, Evatt, Jores and their followers as outgrowths from the lateral lobes. Until comparatively recent times, all so-called median lobe obstructions at the vesical outlet were supposed to take origin in prostatic tubules, whereas in fact the majority of these arise in the subcervical group of glands (Albarran's tubules—subcervical glands), and are not of prostatic origin at all.

Fig. 4.—Fœtal Prostate, with Lower Half of Bladder Attached. Natural size, and ten times natural size. (From a six months' fœtus in the Museum of the Lankenau Hospital.)

Sir Everard Home took credit to himself for discovering a third (middle) lobe, although both John Hunter and Morgagni had recognized median lobe obstructions which may or may not have been of prostatic origin. Home's observations passed practically unchallenged among English surgeons, and enlargement of the third lobe became the most common pathological change to which the prostate gland was subject. In France, however, surgeons were not ready to acknowledge so important a discovery, as this seemed to be, by a foreign author; and they rather grudgingly designated this portion of the prostate the

third or median "part," being unwilling to accord it the dignity of a distinct lobe. Sir Henry Thompson, writing in 1858, opened the controversy anew by pointing out that Home's observations were not numerous and that he had not found his third lobe in every case. Sir Henry therefore came to the conclusion that this middle lobe was merely a pathological formation, and did not normally exist at all. Congenital absence of the median tubules does undoubtedly occur but the rarity of such mal-development is shown in the investigation of Lowsley who found only one among ninety-eight autopsy specimens from dissecting room cadavers and fetuses with absence of the middle

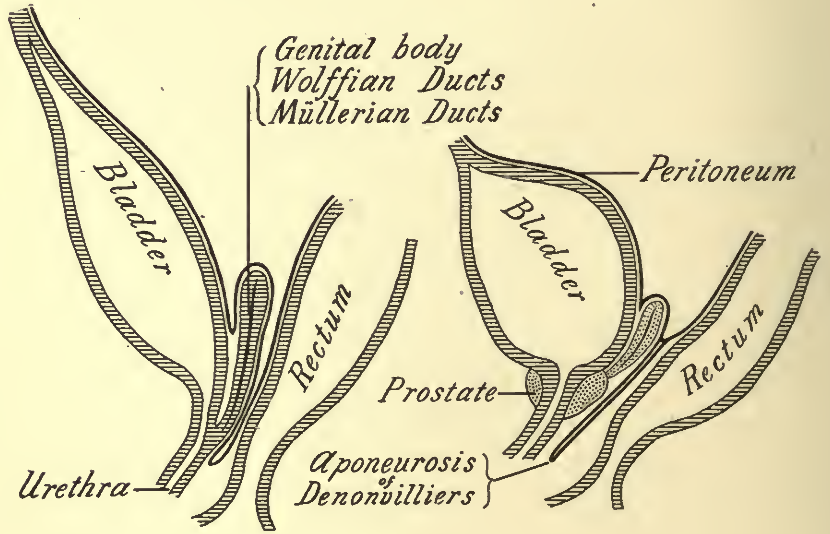

FIG. 5.—DEVELOPMENT OF THE APONEUROSIS OF DENONVILLIERS.—(*Cunéo and Veau.*)

lobe tubules. Home, and later Griffith, found orifices of prostatic ducts on the floor of the urethra proximal to the verumontanum. The secretion which was emitted from these orifices on pressure, the latter found, came from glandular tissue situated between the urethra and the ejaculatory ducts. This collection is now known to have an independent origin from the remaining tubules of the prostate and to retain this independence more or less perfectly throughout life. It is the belief of Tandler and Zuckerkandl that benign prostatic hypertrophy mainly concerns this group of tubules.

A further embryological fact of importance is the formation of a bursa between the prostate and the rectum by the obliteration of the

upper end of a serous process extending downward from the peritoneum. The fascial walls of this closed serous cavity between the prostate and the rectum is widely known as the "aponeurosis of Denonvilliers." In the adult, although separable into two layers, these processes of tissue no longer enclose a distinct cavity.

Comparative Anatomy.—All mammals possess a prostate, but in birds, according to Stricker, there is no analogous organ. In certain of the batrachians he states that the pelvic and anal glands swell up during the procreative season, and discharge their secretion into the cloaca; these glands are supposed to represent the prostate and the glands of Cowper. In fishes there are aggregations of acini that communicate with the vas deferens through ducts. Owen states that insects have three pairs of prostates.

Although all mammals are endowed with a prostate, yet it is by no means identical in form in all. In some mammals the prostate develops around the lower extremity of the Wolffian ducts, and when fully developed retains its close relation to the vasa deferentia, but as two distinct glands, and is not, as in the human adult, applied around the first portion of the urethra embracing the ejaculatory ducts only incidentally. Moullin states that even in man the situation of the prostate was probably originally around the Wolffian ducts, but that its place has become shifted in the course of racial development. In the bull, the buck, and other of the ruminants, indeed in almost all the forms of mammalian life below the human, including the monkey, the prostate continues throughout life a bifid gland. The close resemblance which it bears in some of these animals to the seminal vesicles may account both for the ignorance of the ancients respecting the existence of the human prostate gland, and for the habit of the earliest of the modern anatomists of referring to it as the "glandulæ prostatæ."

W. G. Richardson has called attention to the location of the accessory glands of generation—the prostates, the seminal vesicles, and the Cowperian glands—in various animals. He finds that the seminal vesicles are constantly in relation with that part of the genital tract developed from the Wolffian ducts, that the prostates are placed next, in relation with that part developed from the urogenital sinus, while the glands of Cowper are furthest away from the testicles, in relation with the bulbous urethra. This same general arrangement exists in the human being, the glands of Cowper discharging their secretion into the bulbous urethra, the prostate glands into the prostatic urethra, and the seminal vesicles pouring their secretion into the vasa deferentia

before these látter have joined the urethra. In the lower animals the accessory genital glands differ much in relative size and importance, all three sets not always being present. In the civet cat, for example, Cowper's glands are exceptionally large, apparently to compensate for the entire absence of the seminal vesicles; while in the guinea-pig the seminal vesicles are of immense size, and the glands of Cowper very insignificant in comparison. In the squirrel, on the other hand, the Cowperian glands are very large, and the seminal vesicles are small.

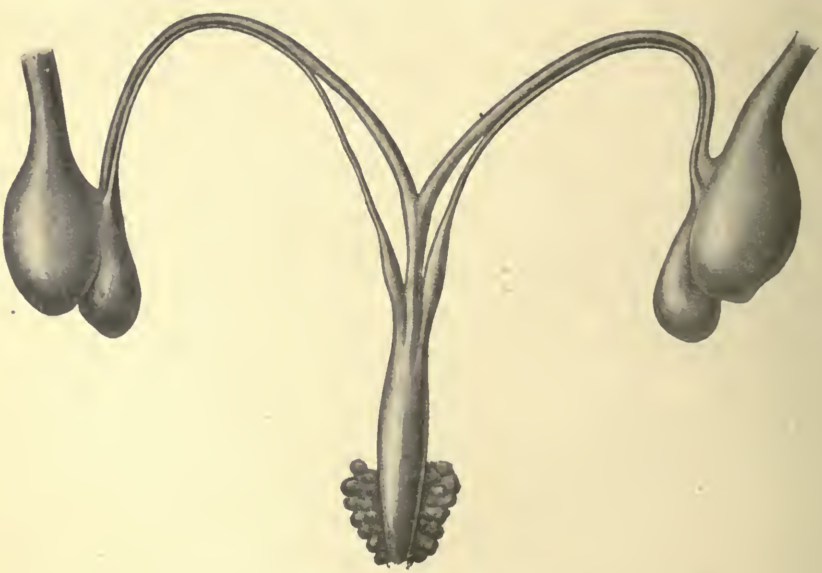

Fig. 6.—Testes, Prostates, and Protometra of the Goat.

Below are seen the prostates. Between the vasa deferentia is seen the uterus masculinus. which is bifid; its two horns diverge and continue, closely applied to the vasa deferentia, as far as the epididymis of each side.—(*After Owen.*)

Genitalia of the goat (Fig. 6) approach most nearly to the primitive or indifferent sexual type. Here the Müllerian ducts persist throughout their length, as well as the Wolffian ducts, and we have the unusual sight of the uterus masculinus extending as a bifid organ from the urethra to the epididymis. Nor do the lower ends of these persistent Müllerian ducts pierce the prostate to empty into the urethra; on the contrary, the prostate glands, one on each side of the urinary channel, are far removed from the situation of the uterus masculinus, being much nearer the bulbous urethra. This satisfactorily disproves the theory formerly held by some that the prostate gland was the homologue of the female womb.

In the hyena the genitalia (Fig. 7) approach more nearly the human in type, but conclusively show that there is no necessary con-

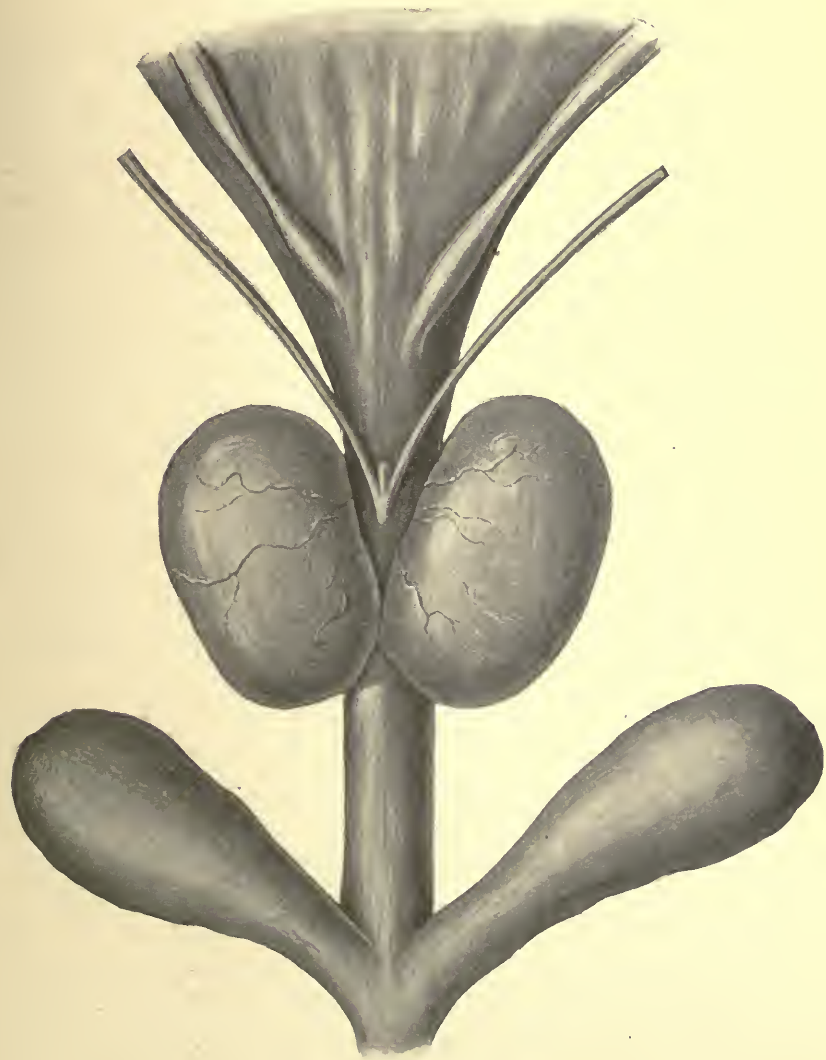

Fig. 7.—Accessory Male Glands and Protometra of Hyæna Striata. Above is seen the bladder. Emptying into the prostatic urethra are the vasa deferentia on each side of the minute uterus masculinus (protometra). The prostate glands are large, somewhat kidney-shaped bodies, in no way connected with the uteius masculinus. Emptying into the penile urethra below are seen the immense glands of Cowper. Natural size.—(*After Owen.*)

nection between the uterus masculinus and the prostate. The Cowperian glands of the hyena are of extraordinary size.

In mammals who have a rutting season the prostate gland enlarges noticeably at this period, and at its close again diminishes to its former size. John Hunter studied the prostate gland in moles, and found that while it was small and insignificant during winter—the period of quiescence—in the rutting season it became very large and was filled with mucus. His observations have been confirmed by Owen and by Griffiths. The last-named author also studied the prostates of hedgehogs, and found them to have the same characteristics.

Such observations as these, taken together with the facts that castration in animals has long been known to produce a certain amount of prostatic atrophy; that failure of development of one vas deferens has usually been found associated with a prostate which is small and ill-formed on the affected side (see Fig. 8); and the theory of "displacement" in the course of racial development, adopted by Mr. Mansell Moullin on the authority of Schäfer; leave no reasonable doubt that the prostate is physiologically a part of the genital and not of the urinary apparatus.

This idea may be further strengthened by a consideration of the ornithorhyncus, or duck-mole. In this animal, a small oviparous mammal of Australia, the urine is discharged through the cloaca, in common with fecal matter, as is the case in birds; and the penis with its contained urethra serves solely and entirely for the transmission of the semen and the fluids from the accessory generative glands. And although, unfortunately for the complete proof of our theory, this interesting animal is not endowed with a prostate, yet it is clear that were a prostate present, its secretion would be discharged along with that coming from Cowper's glands, which, as well as the lower ends of the vasa deferentia, are considerably enlarged. No seminal vesicles are present either, but the enlargement of the lower ends of the vasa deferentia is evidently to compensate for this lack.

In connection with the comparative anatomy of the prostate, a few words in relation to its comparative pathology will not be out of place.

It is well known that of all animals the dog is most prone to prostatic enlargement. According to Ciechanowski, it is also the only domestic animal which suffers from an infectious urethritis. From this fact he draws an argument in favor of his theory that all prostatic overgrowth is due to an inflammatory change.

In other animals castration invariably causes prostatic atrophy; whereas in dogs it frequently fails to have any effect, although it was until recently about the only method of treatment applicable for their

relief. Perineal prostatectomy has also been employed; and Loumeau states that a veterinary surgeon, a friend of his, had employed ten times successfully an operation precisely similar to Freyer's suprapubic prostatectomy, before learning from Loumeau that the same operation had been practised upon man.

Gross Anatomy.—The shape of the prostate is approximately that of a truncated cone, and has often been compared to a Spanish chestnut or a horse-chestnut, having its apex down and forward, and its base beneath the urinary bladder. In size, the gland is normally about four centimetres from base to apex, a little larger in transverse diameter, and from two to two and a half centimetres in depth or height. Its weight varies from fifteen to twenty-four grammes.

The greatest increase in the size of the gland takes place during the second decade of life so that by the beginning of the third decade it has reached its maximum normal development.

The variations in size of the prostate at different ages have been tabulated by Lowsley from a study of 224 specimens, as follows.

TABLE SHOWING THE CHANGES IN SIZE OF THE PROSTATE GLAND AT VARIOUS AGES IN A SERIES OF 224 CASES (LOWSLEY)

Age	Number of cases	Length, centimetres		Width, centimetres		Height, centimetres	
		Variations	Average	Variations	Average	Variations	Average
1st Decade 1–10 years....	38	1.0 to 1.7	1.2	1.0 to 2.0	1.5	0.7 to 1.3	0.9
2nd Decade 10–20 years....	10	2.5 to 3.5	3.0	....	3.8	1.8 to 2.4	2.1
3rd Decade 20–30 years....	40	2.8 to 4.0	3.3	3.6 to 5.2	4.1	2.0 to 3.0	2.4
4th Decade 30–40 years....	33	2.4 to 4.0	3.15	3.0 to 5.0	4.1	1.6 to 3.0	2.55
5th Decade 40–50 years....	42	3.0 to 4.6	3.45	3.6 to 5.0	4.0	2.3 to 3.8	2.65
6th Decade 50–60 years....	29	2.4 to 4.5	3.65	3.3 to 5.0	4.37	2.4 to 3.4	2.75
Old Age 60 years.......	32	2.6 to 4.5	3.23	3.0 to 5.0	4.12	2.0 to 3.6	2.47

The prostate consists of glandular acini and ducts embedded in involuntary muscle; the latter supported by fibrous tissue, constituting the stroma of the organ. This stroma forms, by a peripheral condensation, a capsule for the gland which is distinct from its sheath, the latter being derived from the pelvic fascia. Opinions differ as to the existence of a distinct prostatic capsule. By the use of the term capsule, we do not mean to imply the presence of a definite envelope of tissue that surrounds and is easily separable from the glandular tissue proper. The true prostatic capsule is merely the condensed peripheral portion of the fibro-muscular stroma. This is intimately blended with its intraglandular portion, while externally it is inseparably bound to the anatomic capsule, a fibrous connective sheath which is a part of the pelvic fascia. The capsule referred to in surgical writings as surrounding the adenomatous or enlarged prostate, is, we believe, formed in association with the neoplasmic process. It is, therefore, a structure separate and distinct from those described above.

The fibro-muscular stroma comprises, according to Kolischer, from one-half to two-thirds of the bulk of the prostatic gland. Walker, on the other hand, believes that the prostate is composed of about three-fourths glandular substance and one-fourth stroma. Certain other writers distinguish between a glandular and a muscular type of organ according to the prominence of one or the other element in the histologic picture. In the majority of instances, the stroma constitutes slightly more than half of the bulk of the prostate.

Piercing the prostate from base to apex, a little anterior to its central axis, runs the urethra, whose first part, extending from the vesical orifice behind to the deep layer of the triangular ligament in front, is called "the prostatic urethra." This portion of the urethra is sometimes spoken of as the urethral surface of the prostate gland. Beyond the vesical wall which surrounds its most proximal portion, the pars prostatica is entirely surrounded by the prostate gland. This is the most distensible portion of the entire urethra; when fully distended it is roughly fusiform in outline. When at rest its lumen is effaced through apposition of the anterior and posterior walls. Its lumen is reduced by a spindle shaped elevation to which the terms caput gallinaginis, urethral crest, verumontanum, and colliculus seminalis have been applied. This structure which averages 2.0 cm. in length, 0.41 cm. in width and 0.3 cm. in height extends along the dorsal wall of the prostatic urethra from the uvula of the vesical trigone above to the membranous urethra below.

The summit of the colliculus is situated at about the mid-point of the prostatic urethra, the lumen of which appears crescentic in outline at this point in transverse section. The colliculus exists as a result of an elevation of the floor of the urethra caused by the ejaculatory ducts and the presence at this point of the prostatic utricle, sinus pocularis, or uterus masculinus, the various terms given to a tubular diverticulum whose slit-like mouth occupies the forward declivity of the colliculus. The mouth of the utricle which averages 0.17 cm. in width leads into the utricle proper, which has an average depth of 0.5 cm. Its axis is directed obliquely to that of the prostatic urethra, although lying in the middle line, and its cavity looks forward, so that a small catheter or sound passed along the floor of the urethra may catch in its orifice. A catheter or probe may be easily inserted into the utricle for therapeutic purposes, through an endoscopic tube. Its cavity leads upward and backward into the substance of the prostatic gland. The term uterus masculinus is appropriately applied to it since it represents the fused lower ends of the Müllerian ducts of the embryo, and is, therefore, regarded as the morphological equivalent of the vagina and the uterus. On each side of the verumontanum are found the orifices of the ducts coming from the prostatic acini. The depressed portions of the urethra on each side of the verumontanum into which the lateral lobe tubules empty, are known as the prostatic sinuses. The number of prostatic ducts probably varies within wide limits, being usually from fifteen to twenty. The anterior lobe tubules open on the roof of the urethra at a point opposite the verumontanum. On the sides of this structure and sometimes on its summit to the outer side of the openings of the ejaculatory ducts, are situated the openings of the posterior lobe tubules. The middle lobe empties itself through ducts which open on the floor of the urethra between the internal vesical sphincter and the verumontanum. The position of the prostatic duct openings in relation to the mouths of the ejaculatory ducts insures thorough admixture of the various constituents of the seminal fluid at the time of ejaculation. Emptying into the floor of the prostatic urethra, and consequently coursing through the posterior portion of the prostate gland, are found the ejaculatory ducts of the vasa deferentia and the seminal vesicles. The latter enter the prostate through a transverse crescentic cleft, situated at the junction of its inferior and basal surfaces, and unite within the substance of the gland to form the ejaculatory ducts. These tubes lie close together in their passage through the prostate, their muscular walls blending with each other and with the prostatic stroma.

The latter is well defined in the region of the ducts and serves to separate the lateral and middle lobe tubules from those composing the posterior lobe. Thus is explained the backward displacement of the ejaculatory ducts that takes place in adenomatous enlargements of the middle and the lateral lobes.

The intraglandular portions of the ducts run anteriorly on a gradual slant until they reach the colliculus, where, as Porosz has shown, they

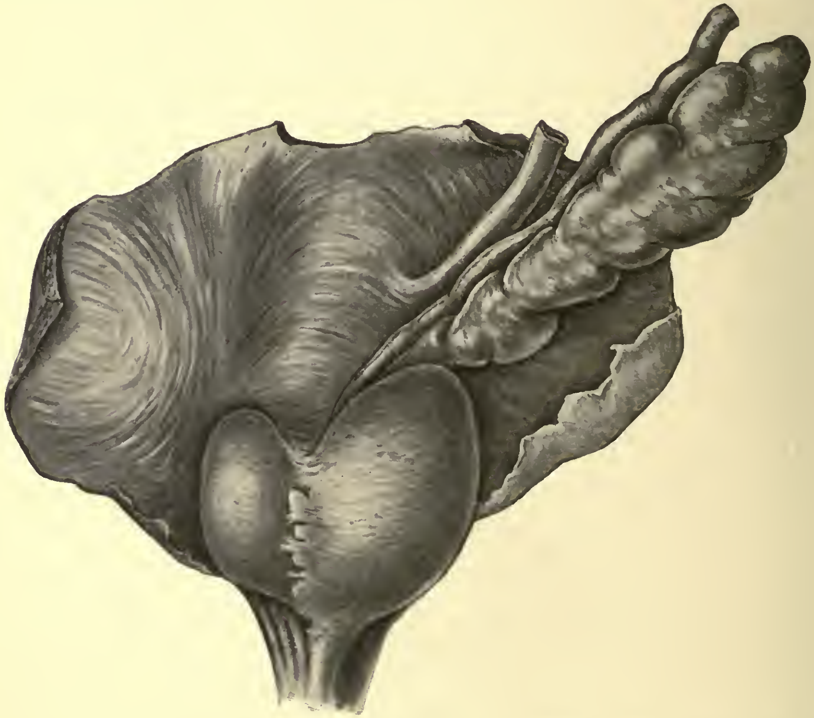

Fig. 8.—Congenital Absence of the Left Vas Deferens and Seminal Vesicle, Associated with Imperfect Development of the Prostate on the Side Affected.—(*Socin, after Launois.*)

bend upward, then curve downward and there open laterally on the declivity of the colliculus. He further states that the curve is often a double one, suggesting a hook bent on itself. The lumen of the terminal part of each duct becomes much constricted, and at this point the ducts are said by Porosz to have a complicated sphincter muscle surrounding them which is a part of the prostatic stroma. The mouths of the ejaculatory ducts are protected by small valve-like folds of mucous membrane that effectually close the distal portion of the ducts

when distension of the prostatic urethra occurs. Slight congenital variations in the position of the openings of the ejaculatory ducts are common, and in rare instances they have been found within the margins of the uterus masculinus.

The prostate gland is formed by the coalescence of five lobes around the urethra although in adult life the two lateral lobes compose the bulk of the organ. The comparatively small portion of the prostate lying on a plane anterior to the urethra belongs to the lateral lobes which are joined together in front of the urethra by the anterior commissure. The anterior lobe tubules undergo early and often complete atrophy. The exact depth in the prostate at which the urethra is found largely depends upon the extent of the forward growth of the lateral lobes. In some few instances the urethra merely grooves the anterior or upper surface of the prostate; but in the majority of cases it is situated with one-third of the organ in front and two-thirds back of the urethra. The wedge-shaped part of the gland situated between the floor of the urethra and the ejaculatory ducts constitutes the middle lobe, while that portion bounded anteriorally by the ejaculatory, laterally by the median surface of the lateral lobes, and inferiorly by the inferior surface of the gland comprises the posterior lobe.

The inferior or rectal surface is grooved by a median furrow between the lateral lobes; this marks the location of the posterior commissure. Grossly the normal adult prostate seems to consist merely of the two lateral lobes coalesced around the urethra. It is important nevertheless to keep in mind the location of the middle and the posterior lobe tubules.

The inferior surface of the prostate is rather flat, and rests upon the rectum. In addition to the longitudinal groove, mentioned above, there is also a transverse crescentic slit at the juncture of the inferior and basal surfaces. This, as already mentioned, gives passage to the ejaculatory ducts which sink into the substance of the prostate.

The superior surface is more convex, and is placed about two centimetres or less behind the lower part of the symphysis pubis. The base rests against the "neck" of the bladder, and the apex is in contact with the deep layer of the triangular ligament of the perineum. The axis of the prostate makes an angle of about 45 degrees with the horizon when the individual is in the erect position.

Sheath of the Prostate.—Tracing the transversalis or pelvic fascia down along the sides of the pelvis, we come to the white line of origin

of the levator ani muscle, which stretches from the neighborhood of the pubic symphysis in front to the spine of the ischium behind. At this

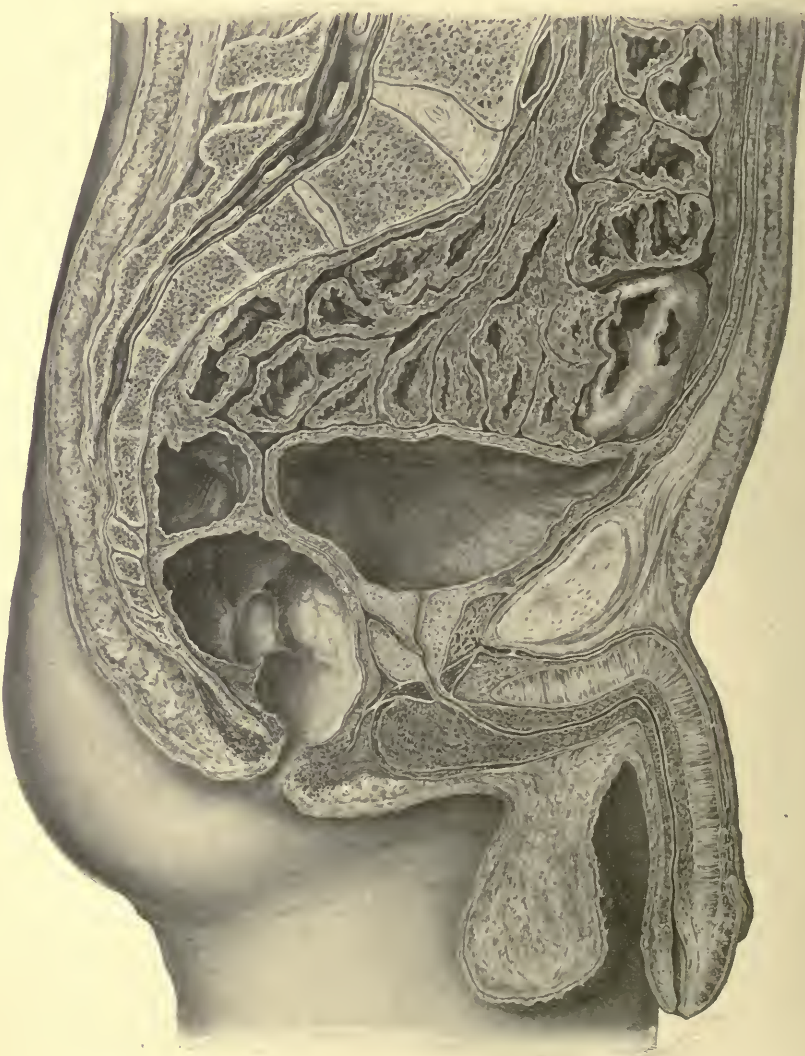

FIG. 9.—MEDIAN SAGITTAL SECTION OF THE LOWER ABDOMEN AND PELVIS, SHOWING THE GENERAL RELATIONS OF THE PROSTATE TO THE BLADDER, THE URETHRA, AND THE RECTUM.

white line the pelvic fascia divides into two sheets, the inferior or external (called the obturator fascia), passing between the obturator internus and the levator ani, and later giving off two processes—one,

on the outer wall of the ischiorectal fossa, encircling the internal pudic vessels and nerve; while the inner layer covers the inferior or

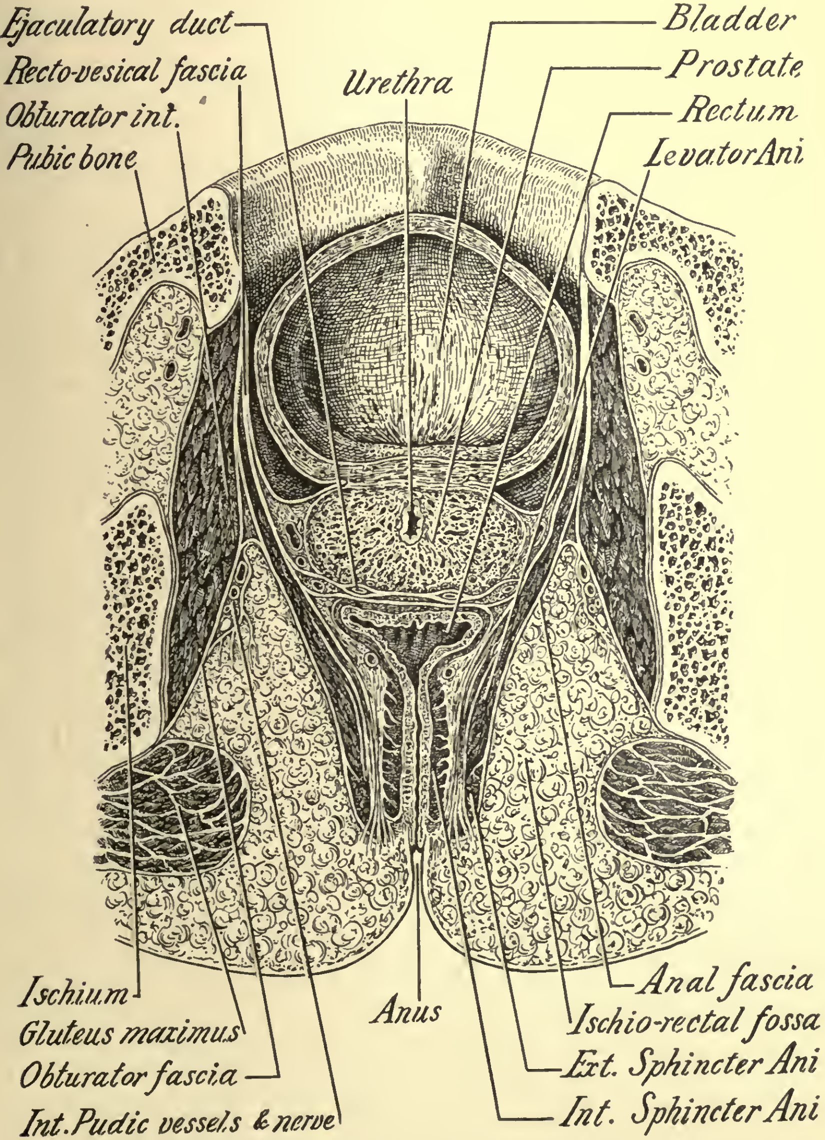

FIG. 1C.—TRANSVERSE SECTION OF PELVIS, SHOWING THE GENERAL RELATIONS OF THE PROSTATE TO THE PELVIC WALLS. LOOKING FORWARD TOWARDS THE SYMPHYSIS PUBIS.

The plane of section is nearly horizontal with the subject in the erect posture.

external surface of the levator ani, and is called the anal fascia. The second original division of the pelvic fascia, called the recto-vesical

fascia, arising at the white line, passes over the superior or internal surface of the levator ani muscle, and subdivides into three layers: (1) The superior layer passes along toward the median line, above the prostatic plexus of veins, and over the upper surface of the prostate, and coalesces with the external coat of the bladder. (2) The middle layer of the recto-vesical fascia passes below the prostatic plexus of veins, beneath the prostate and bladder, and above the rectum, and joins with its fellow of the opposite side. (3) The third and last layer of the recto-vesical fascia hugs the superior or internal surface of the levator ani, and blends with the outer coat of the rectum. The two layers last described form together the aponeurosis of Denonvilliers which lies between the prostate above and the rectum below, and is really a serous sac originally derived from the peritoneum, although more conveniently described here as part of the recto-vesical fascia.

These three layers of the recto-vesical fascia are distinguishable only at the sides of and below the prostate. Toward the median line above they are not separate, but form the pubo-prostatic ligaments, intervening between the most anterior fibres of the levator ani muscle (levator prostatæ of Santorini) and the space of Retzius, and blending at the median line, between these muscular fibres (where they contain the dorsal vein of the penis), with the fascia on the outer side of these muscles—the deep layer of the triangular ligament of the perineum, which is itself a prolongation of the obturator fascia.

Between this sheath of the prostate and its capsule various fibrous prolongations pass, surrounding the venous plexus in a mesh, and binding the prostate in place. Above the prostate these fibrous prolongations form a more or less firm septum, separating the pericapsular space around one lateral lobe from that about the other, and also serving as a medium of support. In cases of long-standing prostatitis and periprostatitis the strength of these fibrous partitions extending among the venous plexus becomes much increased, and great force may be necessary to tear the prostate out of its enveloping sheath.

Thus it is seen that the prostate is enclosed more or less concentrically first, in its own capsule; then within its venous plexus at the sides and anteriorly, and by the bladder above; and, finally, outside of the venous plexus again, passes the sheath of the prostate.

The Prostatic Plexus.—The dorsal vein of the penis passes beneath the subpubic ligament, being provided just before its passage with valves, sometimes three in number; and then divides into two branches

which clothe the sides of the prostate. Here it is joined by veins from the substance of the prostate, and by other minor tributaries, forming the venous plexus of Santorini. No tributaries, however, come from the parietal veins of the pelvis. This plexus lies chiefly on the anterior and lateral aspects of the prostate, and its veins, like others in the pelvis, and in spite of the large number of valves present, are prone to become engorged. In the aged they frequently become varicose, and the formation of phleboliths is not at all uncommon.

This plexus lies within the meshes of the sheath of the prostate, entirely outside of its capsule. Its veins travel backward, receiving veins from the the sides and base of the bladder, and from the cellular tissue about the rectum, and finally empty into the internal iliac veins. Fenwick has shown that this important plexus has three distinct sets of valves, which all tend to prevent backward pressure. One set is found at the commencement of the system; one at the end, in the internal iliac veins; and a third set, which is less constant, about the middle of the plexus. Practically all the veins which enter this plexus are valved, so that Fenwick compares the condition to that of a series of rooms with many different entrances, but only one exit, the result being that the direction of the current is normally always straight onward. The branches received from the internal pudic veins and from the perirectal veins are powerfully valved, so that normally no regurgitation into the hemorrhoidal circulation can take place.

The Arteries.—The arteries of the prostate are numerous but insignificant. They arise from the internal pudic, the inferior vesical, and the middle hemorrhoidal arteries. The largest is the prostatic artery, derived from the hypogastric axis, passing along on the lower part of the sides of the bladder to the prostate. The twigs given off from this artery on the surface of the prostate in part supply its substance, piercing its capsule, and in part anastomose with twigs from the corresponding artery on the opposite side, above the prostate. There are seldom many communicating branches below the gland, while the branches from the internal pudic and middle hemorrhoidal are rarely of sufficient size to be noticed.

Sometimes the internal pudic artery is smaller than usual, and its terminal branches are then derived from the vesico-prostatic, or from an accessory pudic artery, rising from the internal pudic artery just before its passage through the great sacro-sciatic foramen. When they are derived from the accessory pudic, they may be wounded in opera-

tions on the perineum; but when springing from the vesico-prostatic, they lie above the prostate and urethra, and are not so liable to injury.

Nerves.—In the section of this work devoted to the physiology of the sexual organs, we have referred to certain differences of opinion that exist among experimentalists regarding the location of the spinal centres controlling erection and ejaculation. And so it is with the peripheral nerve pathways carrying fibres to and from the spinal centre or centres. The prostate gland is innervated by fibres largely derived from the sympathetic system through the pelvic or inferior hypogastric plexus, some medullated fibres being also found.

The bladder, the urethra and the cavernous tissue of the penis are said to receive their nerve supply from this same source, thus explaining the reflex pain felt at the end of the penis in certain affections of the bladder.

To this statement should be added that the verumontanum, the ejaculatory ducts, the vasa deferentia, and the vesiculæ seminales are similarly innervated, and that the functions of erection, ejaculation, and urination are presided over by nerve fibres running in these same pathways.

According to Eckhard, contraction of the prostatic musculature is dependent upon impulses carried by both the nervi erigentes and the hypogastrics; the former being purely motor, whereas the latter are both motor and secretory. The nervi erigentes were found by Eckhard to arise in the dog from the first and second sacral nerves, and sometimes also from the third sacral nerve. Stimulation of these nerves caused, among other phenomena, expulsion of prostatic fluid. Loeb found that stimulation of the hypogastrics caused contraction of the prostatic tubules; Nuslowsky and Bormann not only confirmed this observation, but also demonstrated that stimulation of these nerves promotes secretory activity in the glandular cells of the prostate.

Langley and Anderson, on the contrary state, that the internal generative organs of the cat and of the rabbit are not influenced by stimulation of the sacral nerves. In these animals, they found that the nerves to the genital organs are carried in the anterior roots of the third, fourth, and fifth lumbar nerves and sometimes also the second. The fibres pass through the sympathetics to the inferior mesenteric ganglia and continue their course by way of the hypogastric nerves. Stimulation of these nerves is said by them to have caused emission of semen from the urethra.

As regards the innervation of the human prostate, the weight of the evidence seems to favor the nervi erigentes of Eckhard together with the hypogastrics.

The Lymphatics.—The lymphatics are both deep and superficial. The former occupy the smaller vessels in the stroma of the gland, while the superficial series lies with the venous plexus between the prostatic capsule and its sheath. These are eventually joined by the deep vessels to form a network on the lower and posterior surface of the organ. This network is drained by two trunks on either side—a superior and a lateral. The upper and smaller trunks are afferent to the obturator lymph nodes of the pelvic wall, while the lateral and larger ones terminate in the internal iliac nodes.

Microscopic Anatomy.—Histologically the prostate is classified as a compound tubular gland. The acini are embedded in a meshwork of involuntary muscle and fibrous tissue, the latter extending as septa inward from the prostatic capsule, which latter is formed by a peripheral condensation of the stroma of the organ. Among the muscular and fibrous tissues and around the acini are found the arterial twigs, the venous radicles, and the deep set of lymphatic vessels. The ultimate distribution of the nerves is not definitely known.

The glandular tissue is most marked in the two lateral lobes and is in greater evidence toward the base than toward the apex of the organ. During the development of the prostate gland three of its original groups of tubules become overshadowed by the greater development of the remaining two groups, the latter forming the lateral lobes which constitute the major portion of the adult gland. Nevertheless it is possible, as Lowsley has shown, to demonstrate microscopically the presence of gland groups in the adult prostate which are distinct and separate from those forming the lateral lobes. These from their location in respect to the position of the lateral lobes are termed anterior, middle, and posterior lobes, respectively. These collections of tubules are not grouped together in such manner that they form lobes which can be recognized in the gross specimen, but they are of more than academic interest for the reason that their participation in neoplastic diseases of the prostate changes materially the clinical picture. To understand the mechanics of prostatic obstruction at the vesical outlet one must appreciate the part that neoplasms originating in each of the five groups of tubules play.

The number of tubules in each of the five lobes varies within wide limits. Lowsley studied many specimens in serial section following each

tubule from its most peripheral portion to the duct orifice; his findings are tabulated as follows:

Middle lobe	0–12–average–	10
Right lateral lobe	10–23	–16
Left lateral lobe	11–23	–16
Posterior lobe	6–12	– 9
Anterior lobe	2–14	– 7

The total average number of tubules he found to be fifty eight, which is a far greater number than is generally ascribed to the organ. The number of tubules is somewhat greater in young specimens but after the age of puberty the number of branches is markedly increased and the complexity of the gland structure is far greater than it is in younger specimens. Branching of the prostatic tubules is most marked near the periphery of the organ. The tubules, as Lowsley has demonstrated, "run obliquely through the muscular and elastic tissues which form the bulk of the gland, and upon reaching the peripheral fourth spread out in many small branches nearly all of which point posteriorly or toward the base of the prostate and resemble very closely a wind-blown umbrella tree with the forward half of its branches removed."

The ducts from each of the five original groups of tubules empty into the portion of the urethra from which they originally developed. In the actively functioning prostate the glandular portion constitutes approximately one-third of the bulk of the organ, due in part to the greater number of tubular branches present, and also to the distention of the tubules with glandular secretion. The ducts are lined close to their orifices in the urethra with a prolongation of the transitional epithelium with which the prostatic urethra is lined; deeper in they are lined with a single layer of columnar epithelium without a distinct basement membrane. The acini themselves are paved with simple columnar epithelium which though usually in a single layer, is frequently stratified, smaller polyhedral elements filling up the crevices between the columnar cells. The cells lining the acini are often granular in appearance, and the nuclei are placed nearer to the basement membrane than to the free end of the cells.

The prostatic tubules comprising the various groups differ very slightly in minute structure. Their distribution within the glandular stroma and the relationship which they bear to each other is interesting. The following description of them is largely based on Lowsley's careful and thorough microscopic studies of the actively functioning gland.

The anterior lobe is composed of from two to fourteen short tubules

which are surrounded by a thin muscular and connective tissue stroma. The ducts open on the ventral wall of the urethra above the point where the ejaculatory ducts open. Lowsley quotes Kuzuitzky as having found a persistent ventral lobe in one out of every fifteen adult prostates. Two cases are mentioned which showed benign hypertrophy of the anterior lobe.

The middle lobe is made up of ten tubules on the average. They are markedly branched resembling in this respect the tubules of the lateral lobes. The middle lobe occupies that portion of the gland bounded by the bladder, the ejaculatory ducts, the urethra, and the two lateral lobes. The middle lobe tubules are quite distinct from those of the lateral and posterior lobes, being separated from them by definite fascial planes. Their ducts open on the floor of the urethra posterior to the verumontanum. The tubules project upward behind the sphincter of the bladder, some of them lying in contact with its fibres but none of them actually projecting within the sphincter muscle. This relationship is important to remember in the study of intravesical growths originating from the middle lobe.

The lateral lobes are the largest of the prostatic lobes. Each lateral lobe consists of sixteen large and branching tubules whose ducts open into the urethra in the prostatic furrows on either side of the verumontanum and is on the sides of the structure. These tubules extend upward behind the sphincter but are contained within the fibrous capsule of the gland, differing in this respect from the middle lobe tubules some of which penetrate and extend beyond this envelope. The capsule of the prostate is very thin in the region of the base of the gland especially at the point where the urethra enters it. This point of weakness in the sheath explains, in part at least, the tendency of neoplasms originating either from the middle or the lateral lobes, to invade the bladder by way of the urethral orifice.

The majority of the tubules of the lateral lobes are directed upward, a few project toward the triangular ligament and occupy the apical portion of the gland. Practically all of the duct orifices are found on a level with, or distal to the openings of the ejaculatory ducts and are therefore distinctly separated from the openings of the middle lobe ducts which open on the floor of the urethra proximal to the verumontanum.

The posterior lobe consists on the average of nine tubules. This is the least definite of the lobes in the adult specimen. The tubules comprising it are in intimate association with the lateral lobes;

its ducts as well as those of the lateral lobes open in the prostatic furrows and on the sides of the verumontanum distal to the openings to the ejaculatory ducts. Lowsley compares the posterior lobe to a wedge "with its base at the apex of the prostate, its apex being found posteriorly from the point where the ejaculatory ducts begin their oblique passage through the prostate."

The boundaries of the posterior lobe are, the ejaculatory ducts and the lateral lobes anteriorly, the base of the prostate above, the apex of the prostate below, and the lower or rectal surface of the prostate posteriorly.

In some places a thick sheet of fibro-elastic tissue separates the lateral and the posterior lobe tubules, but elsewhere the dividing line is most indistinct. According to the investigations of W. H. Boyd and of J. T. Geraghty, benign hypertrophy rarely if ever originates in the posterior lobe, while primary cancer rarely or never begins in any other portion.

After careful dissection of forty-two specimens, including a number of bodies of patients upon whom prostatectomy had been performed—in one instance two years before—Tandler and Zuckerkandl conclude that generalized hypertrophy of the prostate does not occur and that hypertrophy of the posterior lobe is practically unknown. The middle lobe, on the contrary, was so often found the seat of adenomatous growths that these investigators conclude that the middle lobe tubules are chiefly concerned in prostatic hypertrophy, and that much of the remaining portion of the gland suffers pressure atrophy as the result of the encroachment of the enlarging tumor mass.

A further proof that the posterior lobe tubules are not involved in benign hypertrophic processes is found in the fact that in practically all cases the ejaculatory ducts are displaced posteriorly. This would not occur if the tumor mass took origin in the posterior lobe tubules which lie posterior to the ejaculatory ducts.

Lowsley calls attention to the fact that in the performance of a perineal prostatectomy the thick surgical capsule which must be cut through before exposure of the adenomatous masses can be made, is composed of the compressed tubules and the stroma of the posterior lobe. Histologically the posterior lobe tubules differ only slightly from those of the lateral lobes.

Accessory Glands.—Certain glandular structures of independent origin, and probably having no functional relationship with the prostate gland, are found in the region of the internal vesical sphincter. The

most important of these are the subcervical group of Albarran, which consists of thirty or more branched tubules whose ducts open in the mid-line of the floor of the urethra proximal to the verumontanum. The tubules grow entirely within the sphincter muscle of the bladder and occupy for the most part the mucosa, some few penetrating into the submucous coat.

They differ from the prostatic tubules in that they are simpler in structure and are lacking in a definite muscular and connective tissue stroma. Their importance lies in the fact that they are subject to frequent pathological changes resulting in enlargement, and consequent obstruction to the vesical outlet. In twenty-four per cent. of post-mortem specimens taken from men over thirty years of age, Lowsley found these glands enlarged sufficiently to cause demonstrable signs of obstruction in the bladder. The same writer describes a second group of glands, which he calls the subtrigonal group of tubules, as follows:

"They occur in the mucosa of the trigonum vesicæ usually below the central point and are found as far anteriorward as its apex. They are for the most part simple tubules which extend to the submucosa and somewhat into it. In the younger specimens there are no branches, but some of those found during the middle age period show one or two small branches. There is nothing distinctive about the structure of the members of the subtrigonal group. The mucous lining is composed of transitional epithelium similar in type to the vesical mucosa. The cells are much piled up, in some cases five or six deep. Their lumina are quite small, as a rule. These tubules are of importance on account of two facts: because their position is such that an overgrowth or enlargement from any cause will bring about a disturbance in the emptying of the bladder; secondly, because an enlargement of the group does occur in a small percentage of cases. I have observed six non-malignant tumors of the trigonum vesicæ intra-vitam and three in post-mortem specimens. The number of these finger formed tubules increases markedly after birth but are found in the embryo after the fourth month. More than twenty of them are observed in every specimen older than four years."

Young has described cases with pedunculated tumors originating from the subtrigonal group of tubules which caused obstruction by blocking the vesical outlet.

Verumontanum, Caput Gallinaginis and **Uterus Masculinus** are terms applied to an elevation situated on the floor of the prostatic urethra at about its mid-point. The verumontanum averages 2.0 cm.

in length, 0.41 cm. in width and 0.3 cm. in height. It is covered with a mucosa identical in structure with the general lining of the prostatic urethra. The mucous membrane is thrown into longitudinal folds above and below the verumontanum; the upper folds, varying in number from one to five, are in continuity with the uvulæ vesicæ, the lower folds continue downward to the membraneous urethra.

The **verumontanum** is merely a mound caused by the elevation of the floor of the urethra as the result of the passage beneath it at this point of the ejaculatory ducts and the presence between them of the utriculus prostaticus or sinus pocularis, whose walls contribute to the formation of the verumontanum. The sinus pocularis represents the remains of the fused Müllerian ducts and is therefore the homologue of the female uterus. The sinus pocularis is a narrow canal lined with mucous membrane whose mouth, which averages 0.17 cm. in width, opens on the summit of the verumontanum. It extends upward and backward for a distance varying from 0.1 cm. to 0.7 cm. The lining membrane is clothed with stratified, ciliated columnar epithelium. Eight or more compound tubular glands are in communication with the cul-de-sac. The tissues surrounding the sinus pocularis were at one time believed to be erectile, and turgescence of these tissues was supposed to cause the verumontanum to increase in size and to prevent the reflux of semen into the bladder during ejaculation. The presence of erectile tissue in this region is now disproved.

The ejaculatory ducts begin well within the glandular portion of the prostate, being formed by the junction of the vasa deferentia and the ducts of the seminal vesicles. They lie quite close together and the peripheral portion of the muscle fibres surrounding them intermingle. The ducts pass forward on a gradual slant until they reach the posterior border of the verumontanum in the substance of which they run parallel with the axis of the urethra. At the mid-point of the verumontanum they turn sharply lateralward and open on the sides of this structure. These ducts which are approximately two centimetres in length are surrounded near their orifices by sphincter muscles which are merely a thickening of the common circular coat. Their openings are further protected by valve-like folds of mucous membrane which serve to close their lumina when the intra-urethral pressure is elevated. The ejaculatory ducts near their terminals are lined with transitional epithelium which is replaced by cuboidal epithelium at deeper levels.

The musculature of the prostate is in intimate anatomic, and, possibly, physiologic relationship with the musculature of the pros-

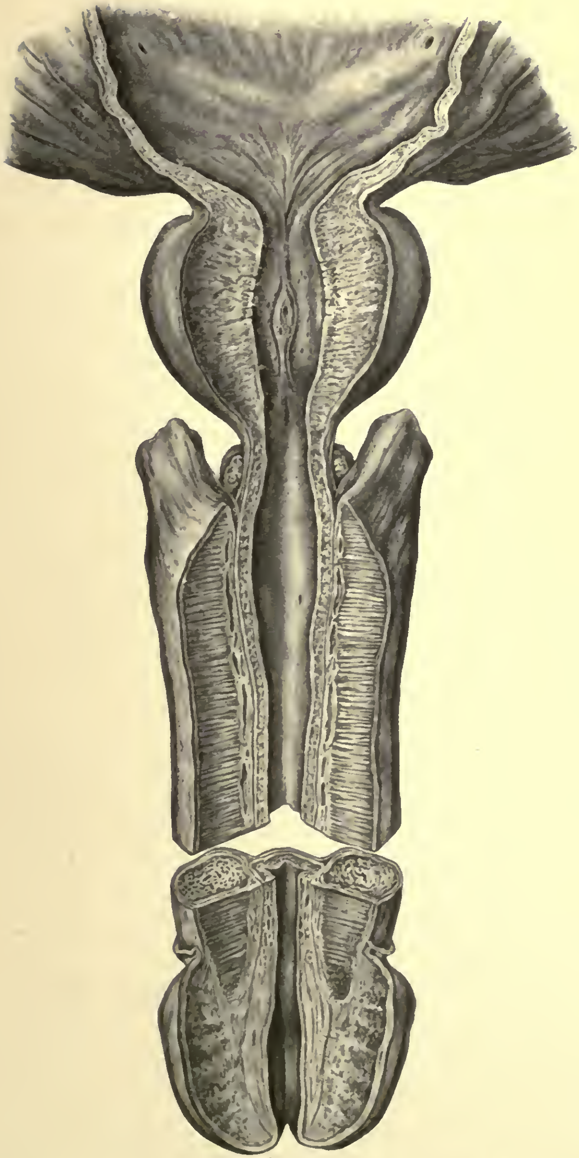

FIG. 11.—URETHRA AND BLADDER LAID OPEN FROM ABOVE, SHOWING IN THE BULBOUS URETHRA, THE ORIFICES OF THE DUCTS OF COWPER'S GLANDS, AND IN THE PROSTATIC URETHRA THE ORIFICE OF THE UTERUS MASCULINUS, WITH THE OPENINGS OF THE PROSTATIC DUCTS ON EACH SIDE OF THE VERUMONTANUM. NOTE THE ORIFICES OF THE EJACULATORY DUCTS ON THE MARGINS OF THE ORIFICE OF THE UTERUS MASCULINUS.

tatic urethra and bladder. These relationships are discussed at some length in the chapter devoted to the physiology of the prostate gland. Suffice it to say here that the muscular fibres of the prostate are arranged in a compact layer around its periphery, forming with the contiguous fibrous tissue, the true capsule of the gland. Wallace asserts that striped as well as unstriped muscular fibres are found among the glandular elements of the normal prostate. Prolongations from the capsule penetrate between the glandular elements, thus providing the gland with

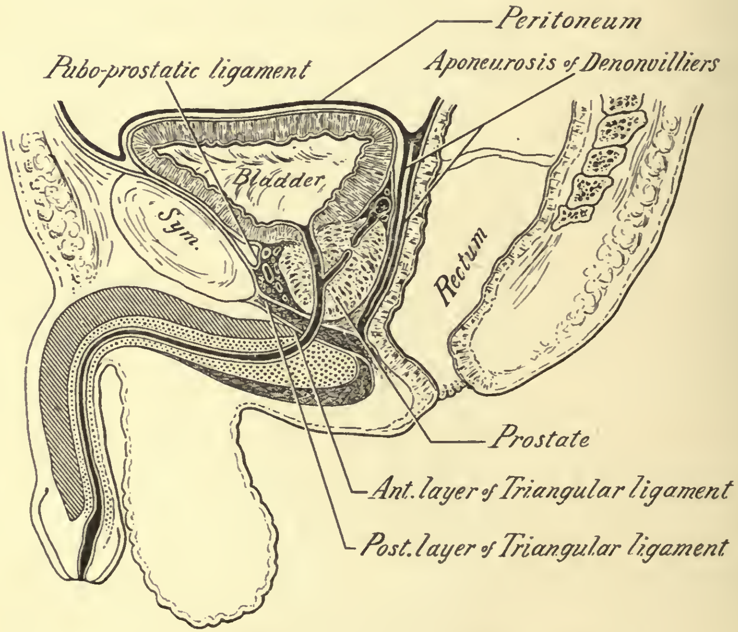

Fig. 12.—Sheath of Prostate in Sagittal Section (Diagrammatic).

a fibromuscular stroma. Each branch of every tubule is surrounded by a heavy muscular envelope. According to Walker, the circular muscle fibres surrounding the acini are more developed, while the ducts are provided with more robust fibres longitudinally disposed.

The terminals of the prostatic ducts are provided with sphincter muscles: these are merely localized thickening of the circular fibres which elsewhere are poorly developed.

Walker has described collections of small round cells in the prostate gland. These he regards as lymph-nodes, but the presence of lymph channels has not been demonstrated except at the periphery of the gland. Weski has studied these structures in human prostates and

believes them to be normal anatomic structures; Waldeyer found similar structures in the prostate gland of the dog.

Collections of round cells are not found in the prostate before the

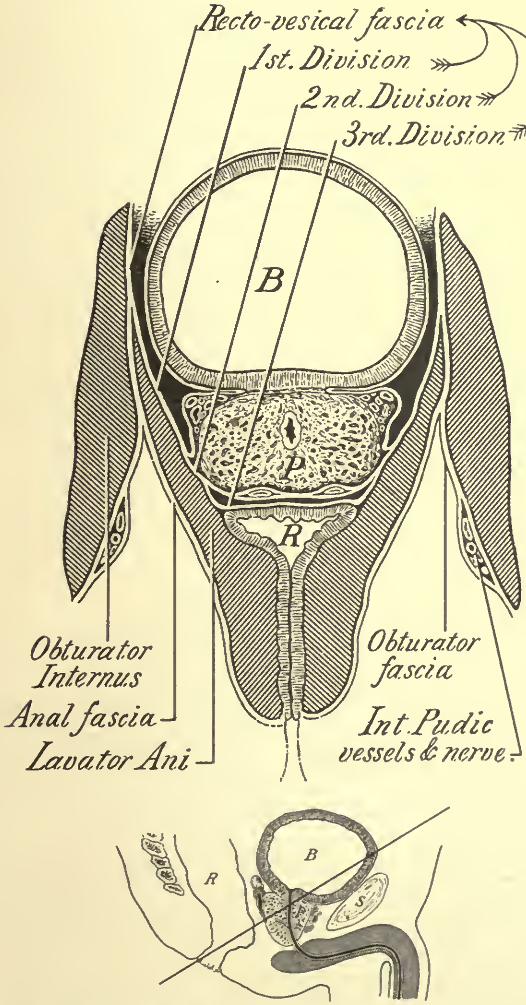

FIG. 13.—SHEATH OF PROSTATE IN TRANSVERSE SECTION. LINE OF SECTION SHOWN IN THE LOWER DRAWING. (DIAGRAMMATIC.)

age of puberty, so that many observers regard them merely as evidence of inflammation.

Elastic tissue is demonstrable in the prostate gland. It encircles the urethra and sends processes in the form of a figure eight to surround the prostatic ducts. just beneath the mucous membrane.

The Lymphatics.—The lymphatics are both deep and superficial. The former accompany the smaller vessels in the stroma of the gland, while the superficial series lies with the venous plexus between the prostatic capsule and its sheath. These are eventually joined by the deep vessels, and together they empty into the lymphatics along the course of the internal iliac vessels.

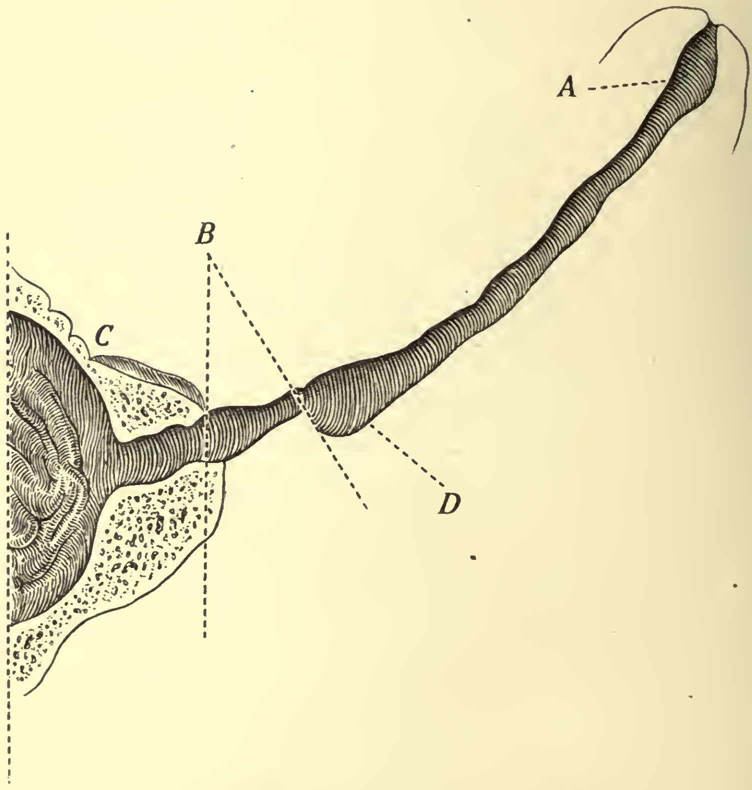

FIG. 14.—NORMAL URETHRA, SHOWING DILATABILITY.

A. Fossa navicularis. *D*. Bulbous urethra. *B*. Membranous urethra. *C*. Prostatic urethra.

The Prostatic Urethra extends from the bladder above to the deep layer of the triangular ligament below, where it becomes the membranous urethra. Its course is at first downward, but toward the termination of the membranous portion it has commenced its upward journey, which is continued in the bulbous portion until the penile urethra is reached, when the curve again changes, and here has its convexity upward. The prostatic urethra is from two to two-and

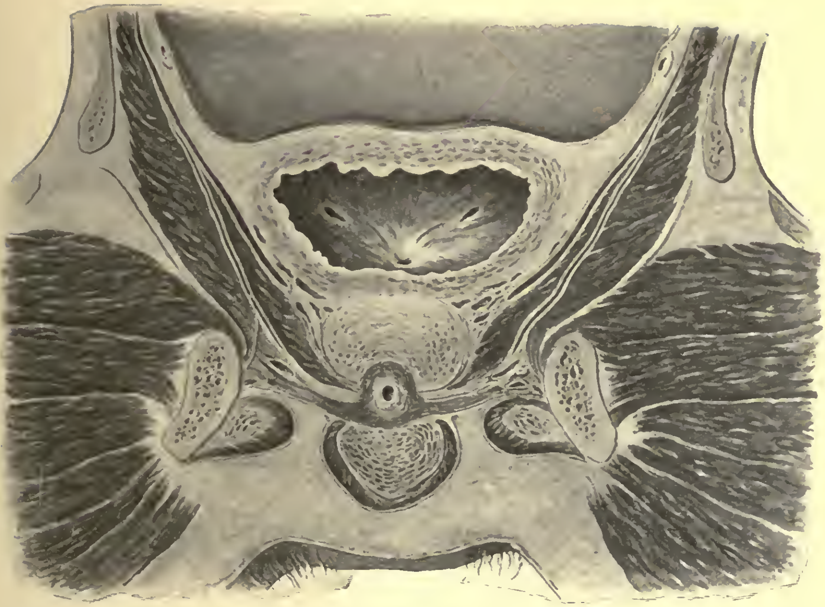

Fig. 15.—Coronal Section of the Pelvis, through the Prostate and the Membranous Urethra, showing the Triangular Ligament of the Perineum. View of the Anterior Surface of the Posterior Segment of the Pelvis.—(*Spalteholz.*)

Fig. 16.—View of the Pelvis from Behind.

Note the white line of origin of the levator ani; the relations of the ureters, vasa deferentia, and seminal vesicles. The prostatic sheath is well shown, also the two layers of the recto-prostatic fascia (aponeurosis of Denonvilliers), and between them the deep layer of the triangular ligament.

a-half centimetres in length, and normally has its sides in contact. Its floor is raised by the verumontanum or caput gallinaginis so that on cross-section it presents a crescentic outline, with convexity above. Its internal diameter is about eight millimetres, but it is the most dilatable part of the whole canal. On its superior wall, just beneath the mucous membrane, are numerous good-sized veins, which, when engorged, may easily be ruptured by a catheter carelessly passed. The mucous membrane of the prostatic urethra is convoluted into longitudinal folds when no urine is passing, and hence is readily adapted to changes in calibre of this canal.

Relational or Applied Anatomy.—Although the state of the parts surrounding the prostate is of greater anatomic interest to the surgeon when altered by disease, yet a clear understanding of such pathologic changes can only be acquired by a thorough knowledge of the normal relations.

Placed in the true pelvic cavity, below the bladder, above the rectum, and about one-and-a-half centimetres behind the lower margin of the pubic symphysis, the prostate is held quite firmly in place by the supporting fasciæ.

From the bladder it is separated only by a thin layer of fascia (the first of the three subdivisions of the recto-vesical fascia) which becomes blended with the outer coat of the bladder and, in the middle line, with the capsule of the prostate. Hence on incising the mucous membrane of the bladder, as soon as the muscularis mucosæ is divided, this layer of fascia presents itself, forming the sheath of the prostate; and as there are in this situation no veins of any size between the prostatic sheath and its capsule, the sheath and capsule are here practically in contact. When the prostate becomes much enlarged, this layer of fascia atrophies or is pushed to one side, and the prostatic capsule presents itself immediately beneath the vesical mucous membrane.

To the rectum the prostate is rather firmly attached by fibrous connective tissue, which may, with care, be separated into two layers, prolongations of the recto-vesical fascia; the lower layer blends with the fibrous covering of the rectum, while the upper sends processes around the seminal vesicles and ampullæ of the vasa deferentia, besides passing below the prostatic plexus of veins to join a similar layer from the other side. This layer remains after the removal of the gland by suprapubic prostatectomy, and, with that immediately subjacent, effectually prevents urinary extravasation into the perirectal and

subperitoneal cellular tissues. These two layers of fascia together form the aponeurosis of Denonvilliers, and the rectum cannot be safely stripped back from the prostate in the operation of perineal prostatectomy until the inferior layer, which is the stronger, has been divided; by so doing the surgeon is admitted into the "éspace decollable rétroprostatique," so eloquently described by Proust.

The recto-vesical fascia forms two thicker bands of fascia in the median line anteriorly, known as the pubo-prostatic ligaments or anterior true ligaments of the bladder. These are attached above to the pubic bones on each side of the symphysis, and are inserted below into the capsule of the prostate on its upper surface, and into the anterior surface of the bladder. When we say inserted into the capsule of the prostate, we wish it to be understood that here, as elsewhere, the prostatic plexus of veins lies immediately outside the capsule of the prostate gland, and that the insertion above described takes place by processes of fascia sent between the veins where they are numerous, and by a coalescence of the sheath with the capsule where the veins are absent. The dorsal vein of the penis, after perforating the deep layer of the triangular ligament of the perineum, lies in the interval between the two pubo-prostatic ligaments, and as they pass on to their insertion into the bladder, it subdivides beneath them into the prostatic plexus. Because fibres of involuntary muscle, prolonged from the bladder-wall, are found beneath the pubo-prostatic ligaments, they are also called the pubo-prostatic muscles.

In the median line anteriorly the recto-vesical fascia (pubo-prostatic ligaments) is in contact beneath the pubic arch with the deep layer of the triangular ligament of the perineum (the dorsal vein of the penis intervening); but to each side of the median line these structures are separated by the most anterior fibres of the levatores ani muscles, which in this situation were denominated by Santorini the levatores prostatæ. These muscular fibres descend upon the sides of the prostate, and unite beneath it; in this situation they blend with the fibres of the superficial transverse perineal, and external sphincter ani muscles, forming the central tendinous point of the perineum. The deep layer of the triangular ligament, it should be remembered, is really one of the ultimate subdivisions of the pelvic fascia, being the continuation toward the median line of the obturator fascia, which lies between the levator ani and the obturator internus muscles.

The urethra emerges from the prostate gland at its apex, about one-and-a-half centimetres below the pubic arch, and passes through

the posterior or deep layer of the triangular ligament to become the membranous urethra. This layer of fascia is firm and tense, and

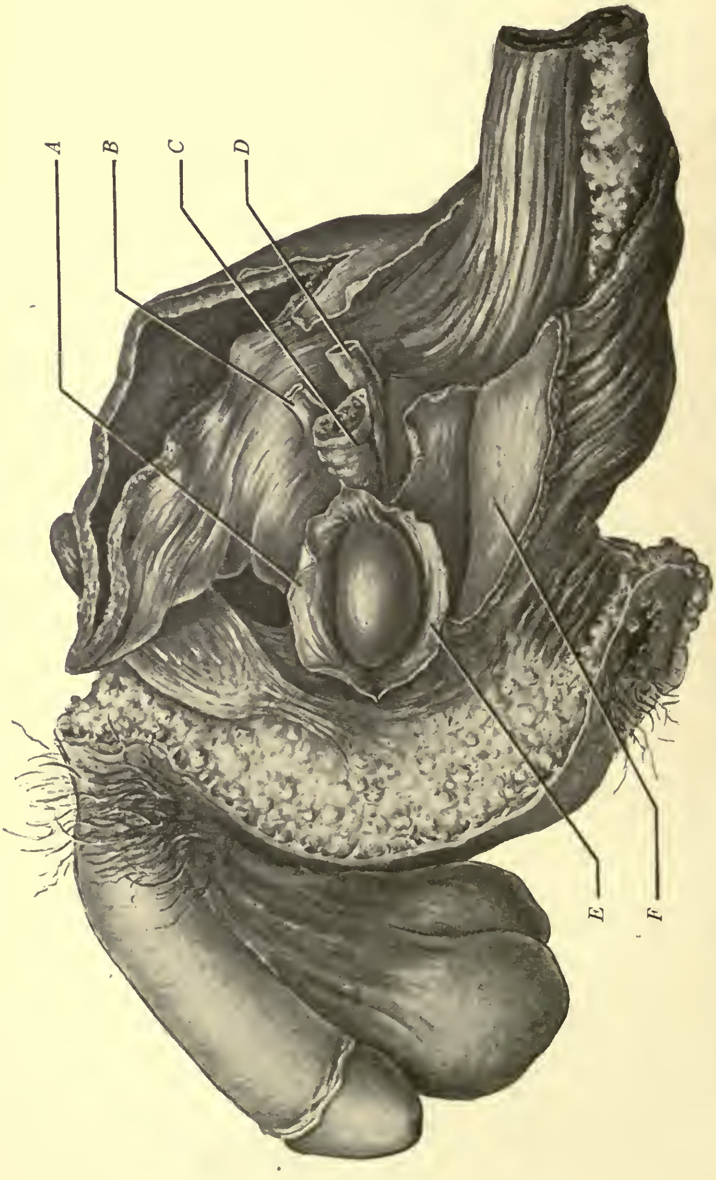

Fig. 17.—Side View of the Pelvis showing the Fasicæ around the Bladder and Prostate.

A. First division of recto-vesical fascia. *B*. Ureter. *C*. Seminal Vesicle. *D*. Vas deferens. *E*. Anterior layer, and *F*. posterior layer of aponeurosis of Denonvilliers (being the second and third layers of the recto-vesical fascia).—(*After Proust.*)

accordingly the apex of the prostate gland is its most fixed portion; enlargement of the organ necessarily extends backward, upward, or downward, never forward. There is no sharp ring where the urethra

penetrates the triangular ligament, as this membrane, instead of terminating abruptly at the circumference of the urethra, is reflected along its surface toward the prostate, and blends with its fibrous coat. Thus a catheter is not liable to be arrested by any ring-like constriction outside the lumen of the urethra.

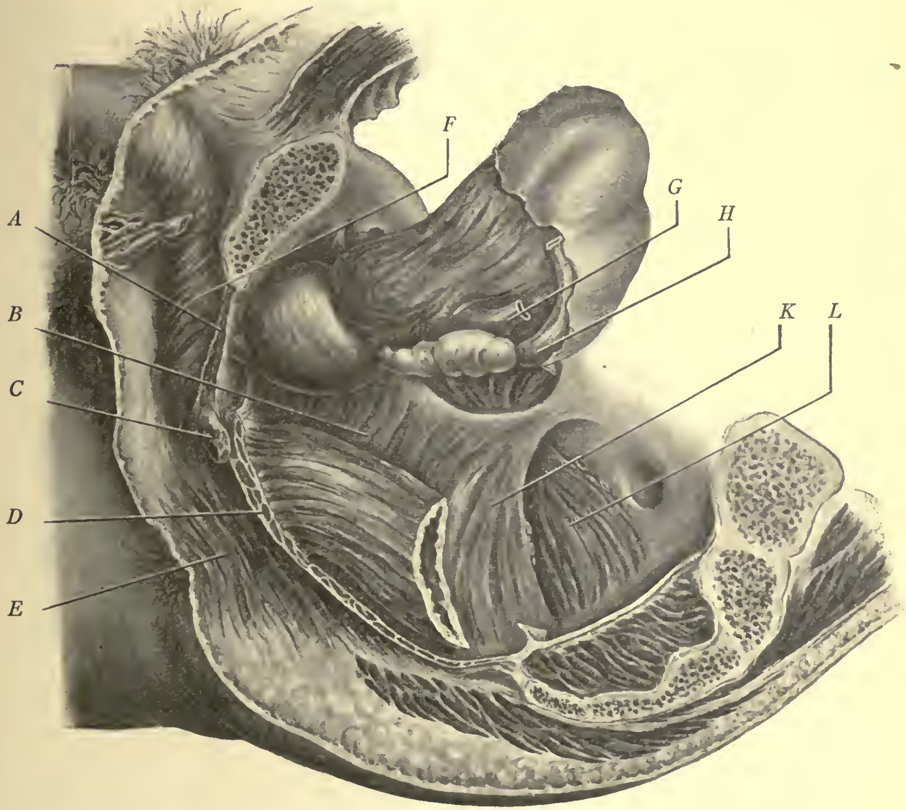

FIG. 18.—SIDE VIEW OF THE PELVIS SHOWING THE MUSCLES AROUND THE BLADDER AND PROSTATE.

A. Triangular ligament. *B*. Levator ani muscle of right side. *C*. Deep transversus perinei muscle of left side. *D*. Cut edge of levator ani muscle of left side. *E*. External sphincter ani muscle. *F*. Bulbo-cavernosus muscle. *G*. Left ureter. *H*. Vas deferens (left). *K*. Coccygeus muscle (right). *L*. Pyriformis muscle (right). The bladder and prostate have been displaced upward so as to expose the levator ani.

The prostatic urethra is normally about eighteen centimetres distant from the external urinary meatus. Any obstruction seated nearer than this to the meatus is not likely to be caused by disease of the prostate.

About three centimetres within the anus the prostate may be felt

as a rounded, firm body of about the size of a horse-chestnut or a little larger. By combined examination with a sound in the urethra and a finger in the rectum much information as to its size and shape may be obtained.

FIG. 19.—SIDE VIEW OF THE PELVIS, SHOWING THE RELATIONS OF THE PERITONEUM TO THE EMPTY AND THE DISTENDED BLADDER.—(*After Gerrish.*)

It is well known that the anterior wall of the rectum undergoes a sharp flexure just within the anus, so that the axis of the rectum is practically at right angles with that of the anal canal. This angle of the anterior rectal wall is produced by its attachment to the triangular ligament of the perineum by certain muscular fibres described as the recto-urethral muscle. The external sphincter of the anus, it will be

recalled, is attached anteriorly to the perineal centre, meeting there with the superficial transverse perineal muscles from the sides, with the anterior fibres of the levatores ani muscles from a deeper plane poste-

Fig. 20.—Dissection of the Perineum.

The attachment of the external sphincter ani to the perineal centre has been divided, and the fascia of Colles has been reflected, exposing the superficial vessels and nerves of the perineum, the superficial transverse perineal muscles, the ischio-cavernosus and the bulbo-cavernosus muscles. Posteriorly, on each side of the anus are seen the levatores ani muscles, clothing the sides of the rectum; on the subject's left the internal pudic artery and branches of the pudic nerve are seen.

riorly, and with the bulb of the urethra anteriorly. On a plane just beneath these structures are met the recto-urethral muscle posteriorly,

and the triangular ligament containing the deep transverse perineal muscles anteriorly. To understand how the levator ani, which between the space of Retzius and the pubic symphysis is on a deeper plane

Fig. 21.—Dissection of the Perineum.

The superficial transverse perineal muscles, the bulbo-cavernosus muscle, and the right ischio-cavernosus muscle have been removed, together with part of the right corpus cavernosum and a section of the corpus spongiosum and urethra. The superficial layer of the triangular ligament, the dorsal vein, artery, and nerves of the penis, and the arteries of the corpus cavernosum are thus exposed.

than the triangular ligament, can become superficial to this structure and the recto-urethral muscle, it must be remembered that the levator ani is like a sling, and hangs down from the pubic bones to surround the

lower part of the rectum, being deficient in the median line under the pubic arch, and only becoming superficial to the triangular ligament back of the posterior border of this structure, where its fibres from the

Fig. 22.—Dissection of the Perineum.

The superficial layer of the triangular ligament has been incised, exposing the deep transversus perinei muscle on the left side, and the internal pudic vessels and nerve on the right side of the cadaver. The duct of Cowper's gland of the right side is seen as it enters the bulbous urethra, after piercing the superficial layer of the triangular ligament.

two sides of the prostate unite at the perineal centre. The accompanying illustration shows these relations very well.

When the bladder is empty, the recto-vesical fold of peritoneum reaches as far as the base of the prostate, or nearly so; but when the bladder is distended with a moderate amount of fluid, the peritoneal

reflection is probably always at least three centimetres above the base of the prostate gland. This explains why the bladder was formerly tapped through the rectum with such success, and shows that in any ordinary operation on the prostate through the perineum no fear need be entertained of opening the peritoneal cavity.

FIG. 23.—DISSECTION OF THE PERINEUM.

The bulb of the urethra and the left deep transversus perinei muscle have been removed. On the subject's left the deep layer of the triangular ligament is exposed. On the right Cowper's gland is seen.

The anterior vesical fold of peritoneum is carried up about five centimetres above the upper margin of the symphysis pubis by moderate distention of the bladder; but as in suprapubic operations the peritoneum is usually recognized with ease, and may readily be stripped

off from the bladder if more room is desired, the relations here are not of such practical interest.

The ampullæ of the vasa deferentia lie between the two seminal

Fig. 24.—Dissection of the Perineum.

The deep layer of the triangular ligament, with all structures superficial to it, has been removed. exposing the perineal portion of the levator ani muscle and its anterior fibres known as the levator prostatæ. The urethra has been cut off at the apex of the prostate gland. The fibres of the levator ani passing underneath the rectum are shown as in the preceding plates.

vesicles upon the rectum, and beneath the neck of the bladder, just above and lateral to the prostate gland, where they can be felt with the finger in the rectum. The ureters run lateral and parallel to the vasa deferentia where the latter are in contact with the bladder wall; at a

higher level the ureters lie medial to the vasa deferentia, the latter having crossed beneath the ureters, and ascend lateral to them. In the small area between the prostate anteriorly, the vasa deferentia at

FIG. 25.—DISSECTION OF THE PERINEUM.

The recto-vesical fascia, forming the sheath of the prostate, and the levator ani muscle, have been incised from the symphysis to the anus, and the rectum has been turned backward The prostate, the seminal vesicles, and the vasa deferentia are exposed. Note the vesico-prostate plexus of veins in the meshes of the recto-vesical fascia. The wall of the bladder is seen above the prostate.

the sides, and the peritoneal reflection above or posteriorly, the bladder is in fairly close relation with the rectum. This is the spot where, when fluctuation could be detected, the bladder was formerly punctured for retention of urine.

The combined ejaculatory duct of the vas deferens and the seminal vesicle of each side penetrates the prostate gland through a transverse fissure on its inferior surface; the two ducts then run forward, and empty into the prostatic urethra on either side of the verumontanum. According to Mr. Freyer, when the prostate undergoes marked adenomatous change, its two lateral lobes tend to become separated again, as they were during fetal life. What is of greater practical importance is the fact that the ejaculatory ducts are displaced backward in the hypertrophied state of the prostate. The intraprostatic portions of these ducts are contained in a fibromuscular septum separating the middle and lateral lobes in front from the posterior lobe behind. Enlargement of either the middle or the lateral lobe would therefore necessarily displace the ducts backward toward the inferior or rectal surface of the gland.

In the suprapubic operation of prostatectomy for benign enlargement of the gland not only are the ejaculatory ducts outside the line of cleavage, but their terminals are not disturbed if care is taken to cut across the urethra proximal to the verumontanum. In conservative perineal prostatectomy Young takes advantage of the posterior displacement of the ducts in that the bridge of tissue containing them is not disturbed by the incisions made to expose the enlarged lateral lobes.

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CHAPTER III

PHYSIOLOGY

In describing the anatomy of the prostate gland we purposely omitted that detailed description of the urethra and urinary bladder which is necessary for a clear understanding of the physiological functions of these parts. The ancient view that the prostate gland took an active part in the act of urination is no longer tenable. Nevertheless the bladder and proximal urethra are so closely associated anatomically with the prostate, and the successful surgery of prostatic enlargement is so largely dependent upon the preservation or restoration of normal urinary function, that the anatomy and physiology of the lower urinary tract are worthy subjects for intimate study.

Structure of the Bladder and Urethra.—The bladder is a muscular sac lined with a mucous membrane and covered on its upper surface with peritoneum. A thin layer of connective tissue uniting the mucous membrane to the underlying muscle coats constitutes a submucous stratum.

The mucous coat consists of several layers of transitional epithelium resting upon a fibro-elastic tunica propria. It presents marked variations in thickness, being quite thin over the vesical trigonum; when the bladder is fully distended it measures only about .1 mm. In the empty bladder, the smooth trigonal mucosa of the distended viscus is thrown into longitudinal folds; under these circumstances the mucosa may attain a thickness of 2 mm. or even more. The trigonal glands to which Waldeyer, Kolischer and others called attention, and which Lowsley has described at some length, are considered by Piersol to be merely tubular depressions and not true glands at all. Young and others have, however, described pedunculated tumors taking origin from glandular structures situated in the trigonal mucosa.

The submucous coat is so designed as to permit free movement of the mucous membrane on the underlying muscular wall. It is a loosely woven substance composed for the most part of fibrous tissue interwoven with elastic fibres which are not easily separated from the mucous and the muscular coats.

The submucosa is wanting in the trigonal area, hence the mucosa is more fixed at this point than elsewhere.

The blood vessels and nerve plexuses are found in the submucosa. The muscles of the bladder wall are involuntary in type and are arranged in three layers, *viz.*—a thin outer longitudinal, a thick middle circular, and an incomplete inner longitudinal layer. The muscular coat is robust and in a contracted state of the bladder measures about 1 cm. in thickness. Enormous hypertrophic thickening of the musculature occurs in certain cases where the bladder is obstructed and infected. When the bladder is distended, the musculature is proportionately thinned out. The outer longitudinal layer of fibres is most prominent on the upper and lower surface of the viscus. This layer is not complete, the spaces between the individual bundles of fibres being filled in with connective tissue. These interfascicular spaces constitute points of weakness in the bladder wall through which the mucosa may herniate, and when there is an obstruction at the vesical outlet or in the urethra result in acquired diverticula.

Muscle fibres from the outer layer are continued anteriorly to the body of the pubic bone, constituting the pubo-vesical muscle; posteriorly the rectum is attached to the bladder by fibres extending from the anterior layer—the recto-vesical muscle.

The circular layer is the best developed and the strongest of the three layers of muscles above the level of the urethral orifice; below this point the circular layer is imperfect so that the trigonal area receives few fibres from this layer.

The inner longitudinal muscle coat is well developed in the region of the trigonum. Elsewhere it is composed of indefinite and indistinct groups of fibres blended with the connective tissue of the submucosa. At the apex of the trigonum the muscle fibres of this layer are condensed and, in conjunction with fibres contributed by the proximal portion of the urethra, form the internal vesical sphincter.

Descriptions of the muscular structures in the region of the vesical outlet are likely to be confusing because of the intimate relationship of the vesical, the urethral, and the prostatic musculature. The proximal two-thirds of the prostatic urethra is derived, as is also the trigonal area of the bladder, from the cloaco-allantois, while the prostate gland forms from tubular evaginations from the primitive urethra, which invade the undifferentiated mesoblastic tissues surrounding the, as yet, undeveloped urethra. This mesoblastic tissue later gives origin to the intrinsic musculature of the prostatic urethra and to the

prostatic stroma. A close association betweeen these structures continues to exist in the adult.

The intrinsic musculature of the male urethra, involuntary in type, is directly incorporated with the walls of the canal. It is divided into two layers, the internal longitudinal layer and the robust external circular layer. The internal layer is continuous with the internal longitudinal muscle layer of the bladder, and extends forward to the openings of Cowper's ducts. The circular muscular coat of the urethra is in intimate relationship with the internal vesical sphincter, although the latter is in reality derived from the middle muscular layer of the trigonum. Muscular fibres within the capsule of the prostate gland intermingle with the fibres composing the circular coat of the proximal urethra, so that there is no sharp line of differentiation between the two sets of fibres. The circular coat is best developed near the vesical orifice gradually diminishing in thickness as it extends forward as far as the termination of the membranous urethra.

The musculature surrounding the prostatic ducts is likewise intimately associated with the circular muscle coat of the urethra. In the removal of an adenomatous prostate by the suprapubic route the musculature of the proximal urethra can hardly escape injury, but the internal sphincter is preserved because it has become displaced outward by the invaginating tumor. In some instances the tumor mass pushes at least a portion of the fibres of the sphincter ahead of it, so that they are liable to injury during the enucleation of the tumor. A groove formed on the surface of the tumor mass denotes the line of separation between the intra-vesical and the extra-vesical portions of the mass, and marks the points of contact of the internal vesical sphincter and the margin of the prostatic sheath. The latter is deficient in the neighborhood of the urethro-vesical junction.

The extrinsic muscles of the urethra are important factors in the physiology of urination and ejaculation. The compressor urethræ muscle, which is contained between the layers of the triangular ligament within the deep perineal interspaces, passes from side to side and encircles the membranous portion of the urethra. It is a voluntary muscle which maintains itself in a state of tonic contraction. Its nerve supply is derived from the internal pubic, which also supplies the remaining extrinsic muscles of the urethra.

Continuous with this muscle above, and considered by some to be a part of it, is the external vesical sphincter. The latter muscle comprises encircling bundles of striped muscle fibres which surround the

urethra at the apex of the prostate and are intimately associated, not only with the sheath and the musculature stroma of the gland, but also with the pelvic fascia, which at this point stretches between the pelvic rami to form the deep layer of the triangular ligament. Above the external vesical sphincter, the extrinsic muscle fibres lie entirely in front of the urethra.

Although the external vesical sphincter is normally held in a state of tonic contraction the strength of its contractions may be increased by the influence of the will.

The nerves of the bladder and of the prostatic urethra comprise both sympathetic and spinal fibres; they are connected with the cord, as are also the nerves of the prostate gland, by means of the hypogastric plexus. From the latter the nerve fibres take two courses, one to the sacral cord by way of the N. erigens, the other to the lumbar cord through the N. hypogastricus. The majority of the fibres from the sacral cord are carried in the ventral branches of the second, third, and fourth sacral nerves.

The spinal fibres are distributed chiefly to the trigonal and urethral regions of the bladder, by far the most sensitive portions of the viscus. The sympathetic fibres, which go to the muscles, follow the blood vessels and break up into fine strings which end in microscopic ganglia. Some of the terminals are found in the substance of the muscle, while others penetrate the submucosa and terminate in ganglia which lie between the epithelial cells of the mucosa.

The urinary function is presided over by a centre or centres in the lumbar cord which in turn are connected with higher centres all the way to the brain cortex. The fibres are said to cross at the level of the fifth lumbar nerve, and a second crossing is said by Langley and Anderson to occur in the inferior mesenteric ganglia. Various centres in the cerebral cortex have been described, and it has been shown that stimulation of any sensory nerve or of any part of the spinal cord will cause contraction of the bladder muscles.

The bladder, the prostate, the seminal vesicles, and the prostatic urethra derive arterial branches from the inferior vesical and middle hemorrhoidal arteries; the bladder in addition is supplied by the superior vesical artery, a branch of the internal iliac artery, and by branches from the internal pudic and obturator arteries. These structures are drained by veins which pass into the large prostatico-vesical plexus at the sides of the bladder and thence into the internal iliac veins.

The lymphatics of the bladder begin within the muscular coat through which they pass and collect to form a subperitoneal plexus. Efferent lymph channels pass, in company with the arteries, upward from the fundus and downward from the apex or body of the bladder and eventually drain into the internal iliac nodes and nodes situated at the bifurcation of the aorta. The majority of the prostatic lymphatics are also tributaries of the internal iliac group of nodes, but some of them drain into the obturator nodes of the pelvic wall.

The Physiology of Urination.—Under normal conditions the urine is retained within the bladder cavity by the action of the internal vesical sphincter. No matter how great the desire to empty the bladder may be, the muscle does not relax until the act of urination is begun; the deep urethra does not, as was formerly supposed, become a part of the bladder cavity when the latter viscus is distended. (This ancient belief is now discarded; indeed the results of experiments undertaken to prove the correctness of this theory have been shown to have been wrongly interpreted.) The contention of Finger and of Oppenheim that the fully distended bladder is pear-shaped because of the inclusion of the deep urethra in the bladder cavity, was first refuted by von Zeissl whose arguments were based on the study of cystograms. Since the publication of von Zeissl's observations, a host of other authors have confirmed his findings, and at the present time it is a generally accepted fact that the internal vesical sphincter retains the urine in all normal circumstances. In the presence of long-standing obstruction in the membranous urethra the parts proximal to it may become dilated so that eventually the internal sphincter may become permanently inadequate to retain the urine, but in normal individuals it is the internal sphincter alone which closes the bladder Normally the length of catheter necessary to draw the urine is the same whether the bladder is fully distended or comparatively empty. This would obviously not be the case if the prostatic urethra became continuous with the bladder cavity in a state of marked urinary distention. In some instances the internal vesical orifice is held open by an invading prostatic nodule which prevents the sphincter muscle from functioning normally. Under these circumstances the deep urethra may become continuous with the bladder cavity, and either incontinence results or the urine is retained within the prostatic urethra and the bladder by the action of the external sphincter muscle.

The final proof controverting Finger's theory came with cystographic demonstrations that the distended normal bladder is an oval or rounded

structure in which there is no suggestion of a vesical neck. Incontinence of urine following prostatectomy usually means injury to both sphincters. Normally the internal sphincter muscle is held in a state of tonic contraction under the control of the hypogastric nerves. The urine accumulates, distending the bladder and putting the detrusor muscle on the stretch. The latter muscle contracts rhythmically sending impulses to the cord and thence to the brain where they are translated into a conscious desire to void. The inhibitory influences of the spinal centre, which latter maintains the tone of the internal sphincter, is removed and the muscle relaxes. Synchronous with this relaxation, the detrusor muscle is stimulated to greater activity and, together with voluntary contractions of the abdominal muscles, elevates the intravesical pressure and the urine is caused to flow with rapidity into the urethra. Thereafter the act is continued reflexly probably as the result of stimuli which arise from contact of the urine with the urethral mucosa; the act, however, is under the control of the will and the reflex action is always subject to intrusions of cerebral influence.

The prostatic gland is entirely passive during the act of urination which is a function of the neuro-muscular system of the bladder and the urethra.

The Physiology of Ejaculation.—The sexual orgasm is essentially a reflex action the centre being located in the lumbo-sacral region of the cord. The reflex is maintained after transverse section of the cord above this level. According to Müller, only the lower part of the cord need be retained in order to preserve the erection reflex. The afferent nerve fibres to the penis, and probably also to the prostate and the vesicles as well as the bladder are carried in the nervi erigentes and hypogastrics. Eckhard was the first to show that the penis of the dog could be erected experimentally by stimulation of the nervi erigentes which come from the first and second sacral and sometimes also from the third sacral nerves.

The orgasm results from the reflex discharge of erector impulses which follow one or more fixed pathways from the erector centre in the spinal cord. The afferent impulses are brought to the cord along widely different pathways. Erection and even ejaculation can be induced voluntarily by stimuli conveyed from the brain. In the treatment of abnormalities of the sexual function supposedly dependent upon pathologic processes in the sexual glands, the physician will do well to bear in mind the psychologic factors involved in so complex a physiologic process.

The emission of the semen, which in the male marks the culmination of the sexual impulse, denotes the termination of a series of muscular contractions; these are said to begin in the walls of the vasa efferentia of the testicles and to pass to the canal of the epididymis and thence along the vasa deferentia. The vesiculæ seminales contract simultaneously expelling their contents into the vasa, and the mixed fluid passes out through the ejaculatory ducts into the prostatic urethra. The prostatic muscles contract at the same time and in addition to expelling the secretion of the prostate also assist in emptying the ejaculatory ducts. The final discharge of semen from the urethra is brought about by rhythmic contractions of the intrinsic and extrinsic muscles of the canal.

In describing the innervation of the prostate gland attention was called to the fact that this gland receives two sets of nerve fibres: one from the nervi erigentes which are purely motor, the other through the hypogastrics which are mixed nerves. Stimulation of the nervi erigentes will cause contraction of the prostatic musculature and the expulsion of prostatic fluid into the urethra. Loeb, by stimulation of the hypogastric nerves, also obtained contractions of these muscles as well as increased secretory activity on the part of the glandular epithelium. Contractions of the muscles of the seminal vesicles and the vasa deferentia are said to follow stimulation of the hypogastric nerve.

Langley and Anderson have shown that the internal generative organs of the cat and the dog are supplied by fibres running in the anterior tracts of the second, third, fourth, and fifth lumbar nerves and thence by way of the hypogastrics. Stimulation of these nerves causes strong contractions of the musculature of the vasa deferentia and uterus masculinus; the contractions being strong enough to produce the emission of semen from the urethra.

Marshall calls attention to the fact that the ejaculation of semen is of some complexity involving more than one centre in the spinal cord. He is of the opinion that the centre for the final expulsion of semen must be the same as that for erection since the muscular mechanisms concerned are to a large extent the same. The contractions of the prostatic musculature are governed by the same spinal centres and the same nerve tracts.

The Physiology of the Prostate Gland.—The chief function of the prostate gland is to furnish a liquid medium chemically and physiologically suitable to the needs of the spermatoza in their passage from the genital glands. Whether it is an inert medium or one without

which the spermatozoa could not function normally, is not definitely known. Fürbinger and Kolliker were the first to maintain that the prostatic fluid has a stimulating effect on the motility of the spermatozoa. Steinach contributed the observation that prostatic fluid when added to the spermatozoa suspended in normal saline solution prolongs their lives. Iwanoff, on the contrary, has shown that spermatozoa uninfluenced by prostatic fluid are capable of fecundation, while a host of other writers attest the activity of sperm derived directly from the testicles by aspiration. These observations would seem to indicate that the prostatic fluid is not vitally important to the spermatozoa.

Testicular fluid is alkaline in reaction, and as pointed out by Adams, that of the prostate is acid in reaction, hence it may be inferred that the prostatic fluid has an important neutralizing effect on the testicular secretion. Fürbinger has shown that excessive amounts of prostatic fluid have a lethal effect on spermatozoa. Steinach, moreover, has demonstrated that removal of the seminal vesicles and the prostate gland from white rats, while not diminishing the sexual passion and the ability to perform the sexual act, including the actual discharge of spermatozoa, prevents entirely the fertilization of the ova; removal of the seminal vesicles alone markedly weakens the fertilizing power of the semen.

It is not known whether the prostate furnishes an internal secretion to the body; that it furnishes one of any considerable consequence is at all events unlikely.

Serrallach and Parés have contributed the results of experimental work indicating that the prostate secretes an internal secretion which controls the testicular functions and regulates the process of ejaculation. It is stated that removal of the prostate causes spermatogenesis to cease, and causes also a cessation of the secretory activity of the accessory sexual glands. The results of these experiments have not been enthusiastically supported. That there is a close physiological relationship between the secretory activities of the several genital glands is not to be questioned, and it is reasonable to suppose that internal secretions are the media of control; that the most important internal secretion is of prostatic origin is, however, extremely unlikely.

Macht has reported some highly interesting observations on the influence of dessicated prostatic substance on the growth and development of tadpoles, which seem to indicate the presence of an internal prostatic secretion.

Various tadpoles were fed with prostatic tissue obtained from human operative specimens as well as from certain of the lower animals and the results were controlled by comparing them with the effect on other tadpoles with various other glandular substances. The results of feeding with prostatic tissue, which were striking, manifested themselves not only in stimulating normal growth and differentiation of the larvæ, but, what seems to us of more significance, in stimulating growth to a size above that which is normal. Macht draws the following conclusions from his work:

(*a*) "It was found that prostatic tissue feeding tended to stimulate both the growth and metamorphosis of the larvæ of the frog, toad and salamander.

(*b*) These observations speak in favor of an internal secretion of the prostate gland."

Griffith has shown that the prostate gland in the hedgehog undergoes definite cyclical changes. In both man and animals the growth and development of the prostate gland would seem to depend upon the maturation of the cells lining the seminiferous tubules, since full development occurs only after the establishment of puberty. It will be recalled that the operation of double castration for the cure of prostatic hypertrophy was based on the theory that the abnormal growth was dependent upon an internal secretion supplied by the testes. Atrophy of the normal prostate occurs after castration in patients who have passed the age of puberty. Much experimental evidence has accumulated which proves that this function of the testes is independent of its spermatogenic function. Familiar clinical examples are found in cases of cryptorchidism in which normal prostatic development has taken place and in which the secondary sexual characteristics have developed normally with unimpaired sexual potency in the complete absence of spermatogenesis. The sterility caused by *x*-rays is due to the specific action of the rays on the spermatogenic cells; the cells of internal secretion are not affected by them.

That there is an internal secretion elaborated by the prostate gland, the function of which is to stimulate spermatogenesis, is extremely doubtful.

The Prostatic Secretion.—The normal prostatic fluid is a thin opalescent fluid containing numerous minute, round, homogenous bodies, lecithin, a few large granular elements, and a moderate number of leucocytes and round and columnar epithelial cells.

According to Gley and Camus, the prostatic secretion contains

a ferment, vesiculose, the action of which causes clotting of the seminal fluid. In certain rodents the seminal clotting is said to be for the purpose of preventing the escape of the spermatozoa from the female passages, thus helping to ensure fertilization.

Lataste was the first to call attention to the clotting of seminal fluid within the female passages and refers in his writings to the clotted seminal fluid as the "bouchon vaginal" the formation of which is now attributed to a ferment elaborated by the prostatic cells.

The prostatic secretion is alkaline to litmus and acid to phenolphthalein. According to Fürbinger, it contains spermine, which when brought into contact with the phosphates secreted by the other genital glands produces Böttcher's crystals. Concretions are frequently found in the prostatic acini in advanced life and also sometimes in the prostates of young men. These concretions, or corpora amylacea, occur also in the alveoli of the lung. Their nucleus is probably mucoid material and broken down epithelial cells; while the concentrically arranged layers of prostatic concretions are formed either by the stratified accretion of the hyaline debris of cells or of inspissated prostatic secretion. The amount of solid matter in corpora amylacea has been estimated at from 46 to 86 per cent. The prostatic fluid contains only about 1.5 per cent. solids which are mostly proteids and salts.

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CHAPTER IV

ETIOLOGY AND PREDETERMINING FACTORS OF BENIGN PROSTATIC HYPERTROPHY

Etiology.—We are tempted to dismiss the subject of the etiology of benign prostatic enlargement as did that most experienced of all modern prostatectomists, Mr. Freyer of London, by confessing our complete ignorance of the cause of the condition.

It is undoubtedly true that but little has been added to our knowledge of the etiology of prostatic hypertrophy within the past fifty years; certainly the true cause or causes of the adenomatous form of the disease have not been demonstrated.

Careful statistical studies of large series of cases and of specimens removed at operation which would, it was hoped, throw some light on the etiology of the disease have failed to reveal the exciting cause of prostatic hypertrophy. Indeed, the most diverse views are held regarding the anatomical characteristics of the disease. Yet practically everyone is agreed that there do exist two main pathologic types of benign enlargement of the prostate which give rise to urinary obstruction in men past the age of fifty years: one in which there is a disproportionate increase in the size of the prostate due to the formation within the organ of tumor-like masses which are composed of tissue whose elemental structure is identical with that of the normal prostate, and a second type in which there is a disproportionate increase in the fibrous tissue content of the prostate which sometimes causes an increase in the size of the gland, while in other instances it is either not enlarged or is actually smaller than normal. The latter type was at one time looked upon as an end-product in the pathologic evolution of the adenomatous prostate but there is very little doubt among the majority of pathologists that the two processes are separate and distinct, the one being in all probability a true tumor disease whose etiology is shrouded in that same mystery which envelopes neoplastic diseases as a class, the other consequent upon inflammation, usually bacterial in origin. The factors that predetermine bacterial growth in the prostate may not differ from causes that predispose to tumor formation in this organ. To further complicate matters the two types of disease often coexist in the same prostate each adding its influence to the production

of urinary obstruction. The inflammatory lesion is, we believe, frequently engrafted on a prostate already the seat of a neoplasm, for here as elsewhere tumors are prone to become secondarily infected.

It must not be supposed that all benign diseases of the prostate gland causing urinary obstruction are easily divisible into the foregoing types. Examples are frequently met with in which neither adenomatous tissue nor fibroblastic elements are recognizable and the prostate which is small and indurated is found on minute examination to consist largely of fibromuscular stroma which has become increased, often to a marked extent, at the expense of the secreting structure. The condition is obviously not a true hypertrophy, neither is it neoplastic or inflammatory in nature. Personally we believe that, excepting those cases presenting the fibroblastic evidence of true chronic inflammation, all cases of benign senile enlargement of the prostate result from some perversion in the normal involution of the gland. The fact that a mass fulfilling all the requirements of our modern definition of tumor is found in certain instances is due, I believe, to environmental influences.

If we accept the tumor theory of the origin of the adenomatous form of the disease it is encumbent upon us to discuss at some length the theories of tumor genesis in general.

This subject is largely of academic interest, however, and one unsuited for detailed discussion in a book of this kind. If the reader is especially interested in the subject he is advised to consult the chapter on the etiology of tumor diseases written by Professor McFarland for our book, "The Breast, Its Anomalies, Its Diseases and their Treatment."

To those who adhere to the inflammatory theory, the etiology both as regards the exciting cause and the predetermining factors is not a matter of perplexity because the varieties of bacteria and the causes inviting their lodgment and development in the prostate gland are well known. Ciechanowski was the first, and now oft-quoted, advocate of the theory of antecedent inflammation as the cause of senile prostatic enlargement. According to this writer, the modus operandi of the inflammatory factor is a purely mechanical one, the initial step in the process being chronic inflammation of long standing with scar tissue formation about the ducts which results, secondarily, in dilatation of the glands.

The historical evidence for or against infection as the cause of prostatic enlargement is not convincing, nor does the fact that Al-

barran found microscopic evidence of inflammation in all of one hundred cases of hypertrophy prove conclusively that the inflammation was the causative factor in these cases; it is quite as probable that the round-cell infiltration which he found in association with the enlarged prostate was caused by the presence within the organ of the abnormal tissue.

Among the more recent advocates of the inflammatory origin of glandular development in the prostates of old men are Wilson and McGrath.

There is no doubt that inflammatory changes taking place in the subcervical group of glands (Albarran's glands) will lead to urinary obstruction either as the result of glandular development or of deposit with organization of inflammatory exudate, but we cannot believe that adenomatous nodules occurring in the prostatic lobes are the results of inflammatory stimulation. We agree with Wilson and McGrath when they say that the greater part of the bladder troubles of old people are due more to exacerbation of chronic prostatitis than to hypertrophy, but we cannot agree with those who attribute the formation of adenomatous nodules within the prostate to chronic inflammation.

Many clinicians including Rovsing, Pilcher, Young, and Keyes oppose the inflammatory theory basing their conclusions on the following facts:

The usual result of inflammation is atrophy rather than hypertrophy; many patients with hypertrophy of the prostate never had antecedent inflammation of the organ; the early stages of hypertrophy have no constant time relationship with the late stages of gonorrhœa or other inflammatory processes; and hypertrophic processes begin very late after the apparent cure of an antecedent gonorrhœa.

Lymphoid hyperplasia undoubtedly exists in association with the hyperplastic element comprising the enlarged prostate in a large percentage of cases, but the inflammatory element is probably engrafted upon a pre-existing hypertrophy and due in many instances to primary degeneration of the nodules within the gland.

Henry Wade has offered an interesting hypothesis which bases the origin of benign prostatic enlargement on some alteration in a normal internal secretion. Wade classifies the disease as inflammatory in type and suggests for it the name "chronic lobular prostatitis" in differentiation from "chronic interstitial prostatitis," the end-product of which is the sclerotic gland.

He calls attention to the fact that senile hyperplasia occurs in both chronic lobular prostatitis (hypertrophy) and chronic cystic mastitis (abnormal involution). The term chronic lobular prostatitis is just as unfortunate for senile enlargement of the prostate gland as is the term chronic cystic mastitis when applied to the abnormal involutionary changes that occur in the senile breast. In neither instance is the pathologic evidence supporting the inflammatory theory sufficiently clear and convincing; in neither disease does fibroblastic proliferation occur with sufficient constancy to justify the assumption that the condition is an inflammatory one. We are in accord with Wade when he expresses the opinion that the disease is probably due to the abnormal action of one or more internal secretions; we entirely disagree with him when he employs the term "chronic lobular prostatitis" to imply the presence of inflammatory products in the enlarged prostate. Wade denies the neoplastic nature of the hypertrophied prostate. It is entirely probable that so-called prostatic hypertrophy begins similarly to abnormal involution of the breast, but owing to environmental changes, the hyperplastic areas in the prostate become transformed into more or less discrete circumscribed nodules, which, from the physical characteristics that they sooner or later may present, such as distinct encapsulation, may, for all practical purposes, be looked upon as tumors.

Many of the factors that are now considered as predetermining the creation of the sclerotic prostate were once considered etiologic influences in the development of the hypertrophic form of the disease. These factors, which include errors in alimentaion, sexual excesses or irregularities, febrile diseases, etc. will be discussed later.

Velpeau held that prostatic hypertrophy is analagous to fibroid disease of the uterus, basing the analogy on a supposed common embryological origin of the two organs.

The French school headed by Guyon and Launois maintained that prostatic hypertrophy is a local manifestation of general arteriosclerosis. This theory lost cast when it was demonstrated that narrowing and obliteration of the prostatic arteries is rarely found in association with benign senile enlargement of the gland.

The discarded theory of Reginald Harrison who regarded the enlargement of the prostate as compensatory adjustment of a disturbance in the mechanics of urination caused by primary descent of the bladder floor, has been resurrected for the purpose of illustrating how indefinite our views were regarding the condition just a few decades ago.

The true etiologic factors involved in simple enlargement of the prostate gland will probably be found to be identical with those giving rise to benign neoplasms and abnormal involution of the senile breast.

Predetermining Factors.—In the present inexact state of our knowledge of the pathology of prostatic enlargement, it is impossible to speak authoritatively on the factors that are supposed to predispose an individual to this disease. Obviously, if it becomes an established fact that the enlargement of the prostate is a late sequel of inflammation and that we are really dealing with a form of chronic prostatitis, the factors that predispose the individual to the condition are those that predispose to inflammation generally. In addition, to those factors peculiarly prone to cause congestion of the prostate gland thus inviting the activity of bacteria, must be attributed a predisposing influence in the hypertrophic changes that occur later in life. On the other hand, if later studies disclose the neoplastic nature of prostatic hypertrophy, the predetermining factors deserving special consideration will be those to which we now attribute a predisposing influence to tumor formation elsewhere. At the present time we cannot hope to reach any definite conclusion as to the influences exerted by occupation, personal habits, previous disease of the generative organs and similar possible causes of prostatic enlargement.

Race.—It does not appear probable that race *per se*—that is, apart from the personal habits characteristic of any particular race—exerts special influence in predisposing to the disease in question.

The negro race has been held to be rather less predisposed to this affection than is the white. Conner expressed this opinion; Schultz we believe has made a similar statement; but the opinions of both surgeons appear to have been based on general impressions rather than on accurate records, and must hence be accepted somewhat guardedly. Our own impression agrees entirely with theirs, but is based on no more substantial grounds. The well-known salaciousness of the negro, however, should, if all theories are correct, render him rather more liable to prostatic enlargement than the white man; since it is held that prostatic overstrain and former inflammations of the gland are among the most probable of causes for its overgrowth.

In natives of India there is probably little doubt that prostatic enlargement is abnormally frequent. Wanless has given considerable attention to this matter, and his experience shows that enlargement of the prostate with complete retention of urine is quite common in that country. He is of the opinion that the chief cause lies in the

excessive sexual excitement, "for the reason that sexual intercourse is begun earlier and continued later in life than . . . in western countries." Among other possible causes, he mentions the excessive use of curry and hot spices, so common in India. These condiments produce, by their habitual use, constipation and engorgement of the portal circulation; and thus a chronic congestion of the hemorrhoidal vessels arises, which, as already pointed out, tends to impede the circulation in the varicose prostatic plexus. The complete urinary retention which he observed so often in India occurred chiefly at the time of the monsoon rains, when exposure and chilling were almost unavoidable; and in practically every case of urinary retention the cause was prostatic obstruction. Still another cause, and one which favored the formation of phosphatic calculus, was the concentration of the urine due to prolonged work under the hot tropical sun; so much of the bodily fluids being thrown off by the sweat glands that the urine excreted was abnormally concentrated.

In Turkey, also, prostatic troubles are comparatively frequent, chiefly due, according to Wishard, to excessive sexual activity. In China and Japan, however, they are considered to be extremely rare; but probably not alone on account of the absence of the same exciting cause.

Age.—Age appears to exert a marked influence, although it is not any longer regarded as a cause *sine qua non*. More and more it is becoming recognized that it is not the prostatic enlargement which develops first in old age, but that it is the symptoms of this disease which begin to manifest themselves only in the decline of life. Some fifty years ago or more, prostatic troubles in men under sixty years of age were next to unknown. Sir Henry Thompson stated that enlargement of the prostate never occurred under fifty-three years of age; but McGill operated on two men, aged fifty-three and fifty-four years respectively, in whom enlargement must have existed for some time before the patients were seen by him. McGill later reported another patient in whom enlargement existed at thirty-five years. Moullin mentions the age of one of his patients as forty-nine years, and refers to one of Henderson's patients aged forty-eight years, and to other patients of forty-one and thirty-six years; while Mudd reported cases occurring in a young negro of twenty-seven, in a child of five years, and in an infant of thirteen months. But in spite of these unique examples, the fact remains that symptoms due to enlargement of the prostate under fifty years of age are very seldom observed. The

researches of Thompson, Dittel, and others have shown that appreciable enlargement exists in about one-third of persons over sixty years of age, but that it produces manifest symptoms in only one out of every twenty. When the seventieth year has passed without enlargement of the prostate, subsequent trouble from it is very unusual. Humphrey stated that only seventeen out of seventy-two patients between the ages of eighty and ninety years, and only one out of thirty patients over ninety years, presented symptoms of prostatic enlargement.

Hunter McGuire held that while enlargement of the prostate might exist in younger men, yet the symptoms were not manifested until the urinary tract, in company with the rest of the body, showed the results of senile changes. Such an explanation as this is in accord with the fact that natives of India and other tropical countries, as a rule, show symptoms of prostatic enlargement some fifteen or twenty years earlier than do the inhabitants of more temperate climes, their span of life being so much shorter than ours.

The collection of many series of statistics within recent years establishes the fact that prostatic hypertrophy is essentially a disease of senility; age being by far the most important predisposing factor in its development.

True examples of the disease are found in comparatively young men, but these are rare exceptions to the general rule that prostatic hypertrophy is a disease of the declining years of life. We have removed an enlarged prostate by the infrapubic route from a man aged 29 years and have operated on several others under the age of forty, but as shown in the tables given below, the vast majority of our patients have been men well advanced in years.

Prostatism dependent upon lesions involving Albarran's group of tubules, or due to inflammatory infiltration around the vesical neck is frequently met with in young men.

Statistics based on the clinical records of operative cases differ somewhat from those dealing with autopsy material; in the latter the percentage of obstructive factors is likely to favor the extra-prostatic causes, of which abnormalities in the Albarran's group of tubules is most important.

Undoubtedly the disease process in the prostate leading to hypertrophy begins long before the advent of the first clinical signs of its presence appear but, as the following tables show, the majority of prostatics present themselves for operation after the age of sixty years.

Age Incidence of Patients with Benign Prostatic Hypertrophy Tabulated from the Records of the Lankenau Hospital of Philadelphia

45	50	7	
50	55	20	19.6 per cent.
55	60	33	
60	65	71	45.7 per cent.
65	70	52	
70	75	50	25.3 per cent.
75	80	18	
80	85	8	
Total................		269	

Figures approximately the same as the foregoing are reported by Wilson and McGrath from the Mayo Clinic.

50	60	65	17 per cent.
60	70	194	50 per cent.
70	80	116	30 per cent.
80	90	12	3 per cent.
Total................		387	

Lowsley in a careful study of 224 autopsy specimens has given the percentage incidence of the various causes of obstruction at the vesical outlet together with the age incidence of these abnormalities. His tabulated statistics are here reproduced.

Age	Hypertrophy of Albarran's group			General hypertrophy		Hypertrophy of sub-trigonal group	No. of specimens	Percentage of Albarran's hypertrophy	Percentage of general hypertrophy	Percentage of subtrigonal glandular hypertrophy	Percentage of Abnormalities
	Large	Medium	Small	Large	Slight						
First decade, 1–10 years.......	0	0	0	0	0	0	38	0	0	0	0
Second decade, 10–20 years...	0	0	0	0	0	0	10	0	0	0	0
Third decade, 20–30 years.......	0	0	2	0	1	0	40	5.0	2.5	0	7.5
Fourth decade, 30–40 years...	2	0	7	0	4	1	33	27.3	12.1	3.0	42.4
Fifth decade, 40–50 years.......	4	2	4	1	6	0	42	23.8	16.7	0	40.5
Sixth decade, 50–60 years.......	1	2	2	2	1	1	29	17.2	10.3	3.4	3.9
Old age, 60 years and older.....	1	3	3	3	7	1	32	21.9	31.2	3.0	56.1
Total for all ages......	8	7	18	6	19	3224					

Percentage of Albarran's hypertrophies, all ages considered.................. 14.7
Percentage of general hypertrophies, all ages considered..................... 11.1
Percentage of Albarran's hypertrophies, after the 20th year.................. 18.7
Percentage of general hypertrophies, after the 20th year..................... 14.1
Percentage of Albarran's hypertrophies, after the 30th year.................. 22.1
Percentage of general hypertrophies, after the 30th year..................... 17.5

Occupation.—It is not probable that occupation exerts very much influence over the development of prostatic troubles. Some of the earlier writers thought that excessive horseback riding caused enlargement of the prostate; and in more recent times, bicycle or motor cycle-riding, has been held responsible for the production of this condition in certain patients. Probably of more real etiological value in this respect than such direct causes are factors which exert their influence indirectly, such as a sedentary life, or other habits which predispose to pelvic congestion.

Social Habits.—Under the title of "high-living" may be grouped a certain number of influences which undoubtedly make the patient prone to prostatic troubles. The gouty, the rheumatic, the lithemic; the man with hepatic and portal congestion, with a tendency to hemorrhoids, or to varicose veins of the legs, is a not infrequent victim of enlarged prostate; and thus, as Wanless has pointed out, in the case of the Indian noted above, dietetic habits or errors may become potent though indirect causes of enlargement of the prostate gland. In many respects the causes of this malady and those predisposing to the formation of vesical calculus are the same, and the concurrence of the two affections is frequent.

Over-indulgence in sexual intercourse has long been considered a possible factor. From the enlarged and tender prostate of the young masturbator, to the similar organ of the old man who marries a young wife—it has been common to blame the sexual excitement as the efficient cause; but, as remarked by J. William White it is probably quite as logical, if not more so, to blame the enlarged prostate with exciting unnatural desires. In accord with this view was the recommendation of Tobin, who regarded persistence of sexual desires in old men as an indication for double castration. Lydston teaches that enlargement of the prostate is in great part due to its "overstrain," which he defines as hyperfunctional activity of the organ; this overstrain, he thinks, may have occurred in early or middle life (from prostatitis, urethritis, congestions from masturbation or ungratified sexual desires, etc.), and yet may not show itself until past middle life, when a general sclerotic tendency arises—as an old injury to the knee, for example, will only begin to give permanent symptoms when gout, rheumatism, arthritis deformans, or some similar disease make its appearance. Harrison, arguing along lines somewhat opposed to the overstrain theory of Lydston, said: "That the withdrawal of a portion of that function of the prostate in which it has been the most actively engaged, should be

followed by a continued activity in which growth is substituted for secretion, is not, I consider, pathologically illogical." But Hodgson, on the other hand, thought the enlargement might well be due to the necessity which the prostate was under of supplying a fluid for sexual intercourse after the secretion of the testicles had become insufficient for that purpose.

The whole subject of the relations of the testicles to the prostate is quite obscure, and many very contradictory and apparently irreconcilable facts are at hand. The testicles undoubtedly furnish to the economy an internal secretion, the action of which at the advent of puberty produces the sexual characteristics of the individual. If the testicles are removed before puberty, the boy remains of neutral sexual characteristics, and the prostate and seminal vesicles fail to develop. If the testicles are removed after puberty, the sexual characteristics which were then acquired do not disappear, but in some instances atrophy of the prostate and seminal vesicles occurs. Cryptorchism in no way prevents the development of the sexual characteristics, showing that these depend upon the internal secretion of the testicles for their manifestation, and not upon the power of procreation possessed by the individual. From certain observations it seems probable that the prostate is more closely connected with the epididymis and the vas deferens than with the testicle, since some persons have been observed with two normal testicles, but with an undeveloped vas deferens on one side, the corresponding half of the prostate being rudimentary. Likewise a unilateral development of the prostate has been noticed where the kidney and ureter on the same side were absent. Remete was of the opinion that only normal prostates are caused to atrophy by castration; and that the more hypertrophied a prostate is, the less likely is castration to produce any beneficial effect upon it. It is certainly true that removal of one testicle does not usually cause atrophy of the corresponding half of the prostate, even when this latter organ is normal. Moreover, Moses observed a case in which prostatic enlargement developed for the first time some years after double castration. MacEwen, similarly, advocated the theory that the testicles furnished an internal secretion which regulated the growth of the prostate, and that enlargement occurred when the testicular atrophy of age caused this influence to be in abeyance. It is interesting to note the observations of Ciechanowski in this connection. He showed that dogs are the only domestic animals which have an infectious urethritis. It is well known that of all animals dogs are most prone to enlargement of

the prostate. Moreover, in other animals castration invariably causes prostatic atrophy, but in dogs it often fails to produce any beneficial influence.

If the influential internal secretion comes from the testicles, it is difficult to see how ligation or excision of a part of the spermatic cords or vasa deferentia could cause atrophy of the prostate, unless it were by first producing a change in the testicles themselves; indeed, it seems not impossible that the atrophy is due entirely to the physiological rest which is obtained for the prostate through the absence of sexual desire. But, on the other hand, it must be remembered that castration does not always cause a loss of sexual desire. Mere subsidence of congestion is a much more usual result of castration than is actual atrophy. A further fact in favor of physiologic rest being the cause of prostatic atrophy, however its action is obtained, is the observation of Hodgson of a patient, aged thirty-five years, whose penis had been amputated some years before his death: in this case the autopsy showed the prostate, the seminal vesicles, and the testicles all much reduced in size.

All these considerations really bring us back to the proposition with which we started, that excessive sexual intercourse is probably a frequent predetermining factor in enlargement of the prostate gland. It is not, however, the only cause, nor in all probability the most important one. This affection, as is well known, has at times afflicted the most moral and continent of men.

Previous Diseases.—Probably the most prevalent of all causes is a preceding inflammation of some kind. The views of Ciechanowski and others on this subject have already been discussed, and a mere reference to the question is here required. Naturally the most frequent of these inflammations is the gonorrhœal; and although many patients of over sixty years may have forgotten it, or may be unwilling to acknowledge it, yet a negative history in this respect cannot carry too much weight. Even if the inflammation of the deep urethra and the prostate have not been of gonorrhœal origin, repeated attacks of congestion and catarrhal exudation, from other causes, frequently occur in this part of the human frame.

Stricture of the urethra has been thought by some authors rather to militate against prostatic obstruction, from the increased fluid pressure which exists behind the seat of stricture tending to dilate the prostatic urethra. Yet a stricture of some size is present in many cases of enlarged prostate.

Other diseases may act as predisposing causes. Among these,

arteriosclerosis is prominent in the nosological tables of the French school. Other affections, such as cardiac insufficiency, hepatic cirrhosis, or other diseases which cause congestion of the pelvic organs, should also be considered; but their action is very indirect, and probably a mere coincidence, not an actual cause.

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CHAPTER V

PATHOLOGY; GROSS AND MICROSCOPIC

It is necessary to describe under the above headings not only the physical characteristics of the enlarged prostate gland but also certain extra-prostatic causes of chronic urinary obstruction. Among the latter conditions are included median bar obstructions and other pathological changes which occur in the region of the vesical outlet. Our

FIG. 26.—HYPERTROPHY OF LATERAL AND MIDDLE LOBES OF PROSTATE. GREAT HYPERTROPHY OF THE BLADDER.
(*MacCallum, "A Text-book of Pathology." W. B. Saunders and Co.*, 1916.)

efforts will first be devoted to a description of the gross characteristics of the enlarged prostate gland reserving the extra-prostatic conditions for separate description.

Size and Direction of Growth of the Enlarged Prostate.—Any prostate weighing more than twenty-three grams may be considered abnormal. From this size they range up to three hundred and seventy-three grams or over in weight. Freyer has removed one weighing five

FIG. 27.—VIEW OF AN ENLARGED PROSTATE (NO. 1469), MEASURING 2 × 1.5 × 1 CM. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

The patient, D. D., aged fifty-eight years, was admitted to (the German, now) the Lankenau Hospital, May 4, 1903. His bowels were regular; he had used alcohol and tobacco moderately. He complained of a burning sensation after urination. About one month before admission he had evidently suffered from an attack of acute cystitis, being compelled to urinate every ten minutes, and passing only 10 to 15 cc. at a time. His urine was highly colored, red, supposed to be bloody. His pain was more marked on moving about. Formerly he was forced to urinate every twenty minutes during the night; of late he has not urinated so often, usually three or four times in a night. The pain starts just above the symphysis pubis and shoots down the penis; there is also a stinging sensation at the end of the penis.

The operation of suprapubic prostatectomy was performed, and a vesical calculus removed at the same time. Recovery was prompt, and the patient was discharged, entirely relieved of his urinary symptoms, June 3, 1903.

The prostate, No. 1469, which is small and fibrous in character, is shown in the accompanying figure.

hundred and thirty-five grams. He has also removed prostates weighing three hundred and fifteen, and three hundred and eight grams, respectively, with perfect functional result. The measurements of this last gland were twelve and a half centimetres antero-posteriorly, and eight and a half centimetres transversely. The average weight of prostates removed at operation is probably not over eighty-five grams; and the dimensions rarely exceed five centimetres transversely or seven and a half centimetres in the antero-posterior diameter. The greater the amount of fibrous tissue present, the smaller the organ, other

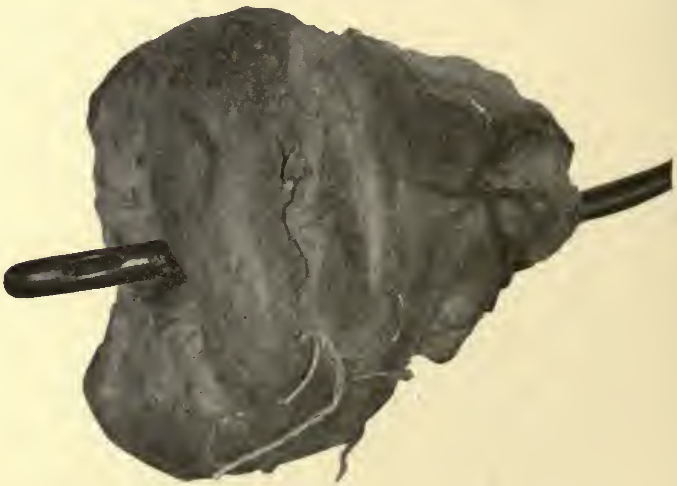

FIG. 28.—VIEW OF AN ENLARGED PROSTATE (NO. 1555), MEASURING 6 × 4.5 × 3 CM. AND WEIGHING 52 GRAMS. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

The patient, J. M. C., aged sixty-three years, was admitted to the (German, now) Lankenau, Hospital July 18, 1903. He has used alcohol moderately; tobacco to excess. Six months before admission he first noticed difficulty in starting the stream, especially in the morning. As a rule, he was compelled to urinate only once during the night, and during the day he passed urine about four or five times. He stated that the amount passed was scanty, and that he had slight pain on starting the stream. One week before admission he had his first attack of retention, caused by exposure to cold and rain. He was relieved by catheterization, and has had subsequently to be catheterized twice a day.

On admission the amount of residual urine was found to be 60 cc. (2 ounces). Rectal examination revealed a hard mass at the neck of the bladder, about the size of a large hen's egg.

Operation (suprapubic prostatectomy) was undertaken a couple of days later. Recovery was uneventful, and the patient was discharged August 14, 1903, entirely relieved of his urinary symptoms.

The prostate, No. 1555, which is shown in the accompanying figure, is a good example of the moderately firm fibrous type of enlargement. Its weight was 52 grams ($1\frac{3}{4}$ ounces).

things being equal, and the greater the relative weight. The average weight of forty adenomatous prostates we find was one hundred and twelve and a half grams; and of ten fibrous prostates the average weight it was sixty grams.

Enlargement of the prostate is almost invariably due to the development within the substance of the gland of adenoma-like

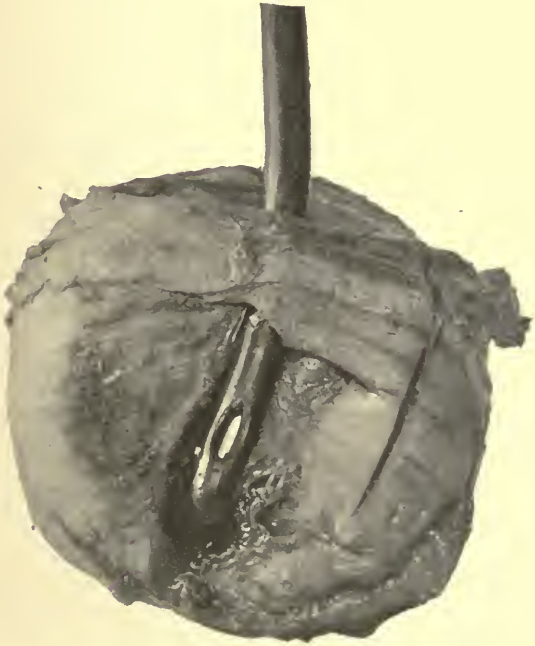

FIG. 29.—VIEW OF AN ENLARGED PROSTATE (NO. 1623), MEASURING 7 × 6.5 × 5 CM. AND WEIGHING 122 GRAMS. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

The patient, T. C., aged seventy-seven years, was admitted to the (German, now) Lankenau, Hospital September 19, 1903. He had been suffering from frequency of urination for years, the calls being more marked at night. Ten days before admission urination became extremely difficult, and three days previously it had become impossible. For two days he had been catheterized by his family physician, but on the third day it became impossible to introduce the catheter.

On admission the bladder was found to be greatly distended, reaching to the umbilicus. A prostatic catheter was passed, several strictures being encountered anteriorly; while in the prostatic urethra there was detected a large false passage, leading to the left. The prostate was greatly hypertrophied, the size of a small orange. The urine obtained by catheterization was very bloody. After treatment by intermittent catheterization for two days, on September 21, 1903, an English catheter was passed, and permanently retained.

Operation (suprapubic prostatectomy) was undertaken September 23, 1903. The patient never rallied, and died from shock and suppression of urine within a few hours.

The prostate, No. 1623, which is shown in the accompanying Plates, weighed 122 grams and is a good example of cystic enlargement.

nodules. These nodules which have a spongy appearance, though varying in density, are surrounded by a more or less complete capsule. The latter is composed of dense stroma with an admixture of muscle fibres. Microscopically the nodules are composed of newly formed glands together with an increased stroma although the latter contributes but little to the actual size of the nodule. Enlargement of the prostate due to hyperplasia of the fibrous connective tissue and muscular elements in the absence of glandular increase is not unknown, but it is an extremely rare type of prostatic enlargement. This variety

Fig. 30.—Hypertrophy of the Median Lobe. The Lateral Lobes are not Involved. (*Watson.*)

must be differentiated from the sclerotic prostate due to inflammatory deposits. True myomata of the prostate must be classified among the pathologic curiosities.

Whether the nodules comprising an enlarged prostate take origin from the glands of the prostate itself, or, as is claimed by some recent writers, from peri-urethral glands is beside the present discussion. The fact is that encapsulated adenomatous nodules are found in the

portion of the prostate nearest the urethra, and that the enlargement is due to the presence of these nodules and not to any demonstrable hypertrophic change in the stroma. The enlarged prostate has a relatively increased proportion of fibrous connective tissue; indeed the individual specimen may be classified according to the proportional amounts of fibrous tissue and glandular elements, some specimens containing a far greater amount of connective tissue than others. The larger the prostate, the less the relative amount of fibrous tissue

FIG. 31.—VIEW OF AN ENLARGED PROSTATE (NO. 1533), MEASURING 6 × 6 × 4.5 CM. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

present, in fact, it is the rule that in the absence of adenomatous nodules the prostate is likely to be either very slightly enlarged or may be normal in size, or even atrophic. Notwithstanding the absence of actual enlargement, the sclerotic prostate frequently causes marked prostatism but for a different reason than applies to the enlarged adenomatous organ. In the case of the latter, the nodules themselves offer an obstructive factor to urination by invading and distorting the lumen of the prostatic urethra and the bladder orifice. The sclerotic

prostate interferes with urination by causing an actual contraction of these parts and is often complicated by median bar formation at the

Fig. 32.—View of the Cut Surface of an Enlarged Prostate (No. 1623) Measuring 7 × 6 5.× 5 cm and Weighing 122 Grams.

vesical outlet. Obviously the treatment appropriate to these widely differing forms of the disease is by no means the same. In the average case of prostatism occurring in a patient sixty years of age or older, the obstructive factor is easily enucleable; in the exceptional instance

enucleation is almost impossible for the reason that the fibrosis has proceeded to the stage where the entire organ has become transformed into a small, dense, sclerotic mass that has become tightly adherent to

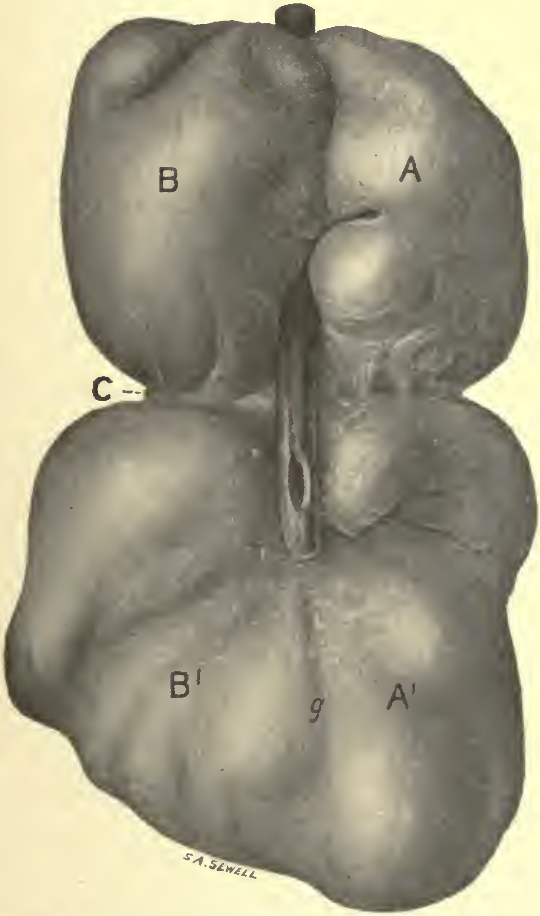

FIG. 33.—PROSTATE WEIGHING 81¼ OUNCES REMOVED FROM PATIENT AGED 79 YEARS.
A. Right Lobe, B. Left Lobe. a'B', outgrowths in the bladder, springing equally from both lobes, the furrow showing the posterior commissure of the prostate. The neck, C, was caused by the grip of the upper margin of the prostatic sheath or recto-vesical fascia, and sphincter muscle of the bladder.—(*Freyer*, *British Medical Journal*, 1919, I, 12.)

the surrounding structures. The difficulties of removing a prostate of this type with the finger need no description for one who has attempted it. The operation can be performed but the gland is literally torn away from the pelvic fascia and other structures to which it has become firmly adherent.

Between the two extremes of the large, soft, freely movable and

easily enucleable nodules and the small densely adherent mass of scar tissue are types presenting all degrees of variation; indeed it is oftentimes a matter of great difficulty to classify a given case clinically and as a corollary, to select the appropriate form of treatment.

Much useless controversy has been indulged in regarding the origin of the so-called middle lobe of the adenomatous prostate. According to Keyes, Jr., some median enlargement is noted in 81 per cent. of cases but this, no doubt, is meant to include all types of median obstruction. Median projections into the floor of the bladder just posterior to the urethra take origin in the majority of instances from the true middle lobe tubules. These tubules lie beneath the sphincter muscle, and between the ejaculatory ducts and the floor of the prostatic urethra. In well-advanced cases the origin of a middle lobe enlargement may be differentiated, but only with great difficulty, from a pedunculated nodule that has become separated through pressure from one or the other of the hypertrophied lateral lobes. A nodule of this type, after invading the bladder cavity by way of the orifice, may seem to spring from the floor of the urethra. The study in early cases of what would in all probability have proven to be generalized hypertrophy, if development had proceeded, indicates that hyperplasia of the middle lobe tubules is a constant and permanent feature.

The process shows a tendency to an earlier and more marked development here than elsewhere, and in the majority of cases the initial obstructive element seems to be a middle lobe hypertrophy. We are not prepared however to accept the teachings of Tandler and Zuckerkandl who believe that so-called generalized hypertrophy of the prostate is confined to the middle lobe. In certain instances the far advanced case of middle lobe hypertrophy presents a more or less movable rounded nodule which effectively serves to obstruct urination by a ball valve action on the vesical outlet. More frequently the nodule projects upward from the floor of the bladder and serves to complete the posterior margin of a collar-like arrangement of the intravesical portion of the hypertrophied lateral lobes, or is situated within a ring formed by these lobes.

The evidences of early hypertrophy of the middle lobe tubules are to be looked for within the urethra where a mound will be found projecting upward from the floor of the canal some little distance proximal to the verumontanum. The walls of the urethra covering the projection remain unchanged for some time. Hyperplasia of the middle lobe tubules is easily demonstrable in these specimens.

A second and quite frequent source of obstruction at the vesical outlet is disease, either hyperplastic or inflammatory, of Albarran's tubules: this group of extraprostatic tubules is subcervical in position and therefore ideally situated to embarrass bladder function in the event of their enlargement. Jores was among the first to call attention to the fact that many of the adenomata situated in the region of the bladder orifice have their beginning in accessory prostatic glands.

FIG. 34.—VIEW OF THE CUT SURFACE OF AN ENLARGED PROSTATE (NO. 1542), MEASURING 7 × 6 × 6 CM. AND WEIGHING 120 GRAMS. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

The result of hypertrophic changes in Albarran's tubules is sometimes seen in the production of a broad median bar but more often of a rounded nodule which is separated from the lateral lobes of the prostatic gland by deep clefts, one on either side. The lobule itself is grossly tri-lobular, the clefts separating the individual lobules being caused by the pressure exerted by Bell's muscle, bundles of which pass over it from the trigonum above to the urethral floor below. These clefts lend themselves beautifully to cysto-urethroscopic demonstration so that this type of median line obstruction is usually diagnosed with ease.

In addition to median obstructions of glandular origin, certain bars composed of fibrous connective tissue occur in the region of the

posterior lip of the vesical orifice. Randall divides these sclerotic bars into two groups: One, the edge of which is narrow and extends from side to side forming an abrupt angle with the sphincteric margin. The trigonum vesicæ is foreshortened and the verumontanum is likely to be found lying just beneath the projecting edge of the bar.

The second type of bar is situated higher, so that the trigonum is affected more than the urethral walls. The verumontanum is not

FIG. 35.—VIEW OF THE UPPER SURFACE OF AN ENLARGED PROSTATE (NO. 1542), MEASURING 7 × 6 × 6 CM. AND WEIGHING 120 GRAMS. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

displaced and the most apparent effect is a transverse folding of the trigonal mucosa. This variety of bar is less likely to cause serious urinary obstruction than its prototype described above; histologically they are exactly the same, both consisting of sclerotic tissue. The relative frequency of these varieties of median bar is given in the chapter on diagnosis.

An infrequent though potent cause of prostatism is wide-spread

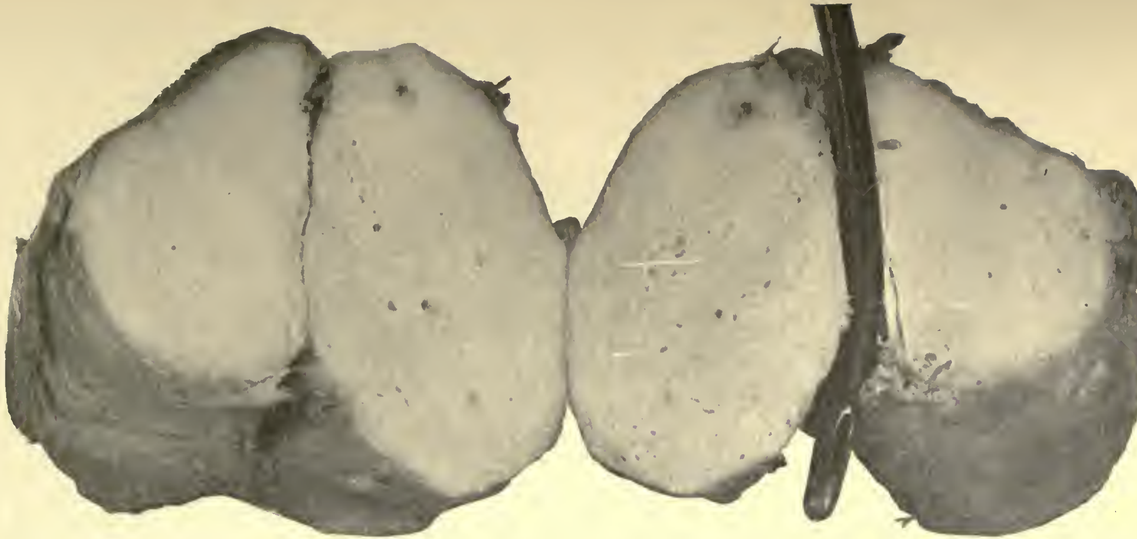

FIG. 36.—VIEW OF THE UNDER SURFACE OF AN ENLARGED PROSTATE (NO. 1542), MEASURING 7 × 6 × 6 CM. AND WEIGHING 120 GRAMS. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

The patient, S. L. T., aged seventy-three years, was admitted to (the German, now) the Lankenau Hospital, July 9, 1903. He states that he has never used alcohol. He had an attack of gonorrhœa when about eighteen years of age. His present illness began two and a half years before admission, with frequency of urination, especially at night; he was obliged to get up every fifteen or twenty minutes to urinate; and often when upon his feet he would pass his urine involuntarily. The flow lacked force, coming in a thin stream. Lately bright blood was present at times. At the beginning of this illness much sediment was passed in the urine.

Examination on admission showed an enlarged prostate, very firm, the size of a lemon.

Suprapubic prostatectomy was performed July 11, 1903. Owing to his advanced age the patient did not react very well, but failed gradually, and died in a uremic state on July 26, more than two weeks after the operation.

The prostate, No. 1542, which is shown in the accompanying figure, is an excellent example of the mixed type of enlargement, being partly glandular (and partly fibrous).

sclerosis in the region of the vesical outlet resulting from prostatitis and peri-prostatitis. The obstructive factor here is not limited to any segment of the ring-like outlet of the bladder but is distributed in an annular manner to surround not only the immediate region of the vesical orifice but also the prostatic urethra. Cases of this kind are sometimes met with in comparatively young men.

FIG. 37.—ENLARGED PROSTATE (NO. 1502), MEASURING 6 × 6 × 5 CM. AND WEIGHING 100 GRAMS.

The patient, H. M. Y., aged sixty-six years, was admitted to the German now Lankenau Hospital June 8, 1903. The patient's father had died of prostatic disease. The patient had always been a moderate user of alcohol. For the past fifteen years he had suffered from frequency of urination, which was most marked at night. Two years before admission he had developed an acute attack of cystitis. In July, 1902, he had been operated upon for vesical calculus, since which time he had had a suprapubic fistula. He had not passed urine through the urethra for six months.

Rectal examination on admission showed a very hard prostate, about the size of a lemon.

Suprapubic prostatectomy was done June 15, 1903; a stone the size of a lima bean was extracted from the bladder, and the prostate removed entire along with the prostatic urethra. Recovery was rather tedious, but the patient was discharged August 1, 1903, in good health, and with no urinary trouble.

The prostate, No. 1502, which is shown in the accompanying figure, was the seat of considerable catarrhal and interstitial inflammation, as seen by the microscopical section, (Fig. 34). Its weight was 100 grams.

FIG. 38.—VIEW OF AN ENLARGED PROSTATE (NO. 2138) WEIGHING 162 GRAMS. VERY MARKED ENLARGEMENT OF THE RIGHT LOBE.

The patient, W. T. D., aged seventy-three years, lawyer by occupation, was admitted to (the German, now) the Lankenau Hospital December 3, 1904. He had always used alcohol and tobacco in moderation. He had had the ordinary diseases of childhood, and had had enteric fever twice, in 1862 and 1863. Since that time he has always enjoyed good health.

For a little more than three years he has had slightly more frequent desire to urinate, with occasional imperative urination. Three years ago, after slight alcoholism, there developed acute retention of urine, which was relieved by the catheter. For a week subsequently a catheter had to be passed twice daily, and since this time the patient has had to be catheterized on the average of once in a week or ten days, sometimes only every two weeks; never with any degree of regularity. The chief indication for catheterization was pain; a considerable amount of urine could usually be drawn, and the patient would urinate generally about five times during the night following these catheterizations, though there would be times when he would not get up at all.

On admission there was found to be residual urine amounting to 60 cc.

Suprapubic prostatectomy was done December 8, 1904. On opening the bladder it was found that the prostate was markedly enlarged, especially upon the right side, which equaled a lemon in size. On attempting to enucleate the whole gland the tip of the much enlarged right lobe broke off from the body of the enlarged organ, and lay free in the bladder. It was removed, and the remaining portions of the prostate were then enucleated in one piece. Uninterrupted recovery followed, and the patient is completely relieved of his urinary symptoms.

The prostate, No. 2138, which is shown in the accompanying figures, weighed 162 grams.

FIG. 39.—VIEW OF THE SAME PROSTATE (No. 2138) SHOWN IN FIG. 38. (a) (b) the right lobe, (b) the intravesical portion. (c) The left lobe.

In rare instances the anterior group of prostatic tubules are concerned in the origin of nodules, which may, or may not cause obstruction to urination of sufficient degree to give rise to clinical symptoms.

Fig. 40.—View of the Upper Surface of an Enlarged Prostate (No. 1826) Weighing 56 Grams. A Catheter has been Introduced through the Urethra.

The patient, A. S., aged sixty-eight years, was admitted to (the German, now) the Lankenau Hospital March 25, 1904. He had always enjoyed good health, and had lived a very active life. For fourteen months previous to his admission he had had frequency of urination, and at times had been forced to use a catheter every fifteen minutes. For the last three months he had been confined to bed with a catheter constantly in the bladder. He likewise suffered from diabetes. His general condition, however, improved so much after the institution of continuous drainage, that an operation was deemed justifiable.

Suprapubic prostatectomy was accordingly performed on March 26, 1904. The operation proved to be perfectly successful. Urine was voluntarily passed through the urethra first on April 6, and the patient was soon afterwards discharged with the suprapubic wound firmly healed, and with his urinary functions in normal condition.

The prostate, No. 1826, is shown in the accompanying figure. It weighed 56 grams and is a good example of irregular enlargement, the projection of the so-called middle lobe making the under surface of the gland nearly clover-leaf in shape.

Physical Characters.—When we come to a consideration of the physical characters of the enlarged prostate other than its size and weight, we find the most important one from a therapeutic point of view is its density. This varies from that of cartilaginous hardness

FIG. 41.—VIEW OF THE UNDER SURFACE OF AN ENLARGED PROSTATE (NO. 1826) WEIGHING 56 GRAMS. A CATHETER HAS BEEN INTRODUCED THROUGH THE URETHRA.

such that the knife creaks as it cleaves the tissue, to a glandular softness which may perhaps best be compared to a wet sponge of close texture. The former characteristic, hardness, is found exclusively in prostates which contain much fibrous tissue, and which we have placed in the second class; while the softer the organ, the more surely may it be considered to belong to the adenomatous group of cases. Between these two extremes all grades of density exist; but few indeed are the cases where it is impossible to place the gland readily in one or the other category.

The rate of growth is variable both of the gland as a whole, and of its individual parts. The soft glandular prostates grow with greatest rapidity, and may furnish evidence of increase in size to the palpating

finger within a period of a few months. Extremely rapid growth occurs only in malignant neoplasms. The fibrous prostate grows slowly, and, as already remarked, rarely equals the glandular in size. Some authors have even contended for a progressive decrease in size occurring in this form, constituting true prostatic atrophy; but their views have not met with unreserved acceptance. Undoubtedly there is an actual decrease in the size of the prostate in certain long-standing cases of prostatitis and peri-prostatitis. In advanced cases it may be found

FIG. 42.—MEDIAN SAGITTAL SECTION OF THE BLADDER AND PROSTATE. Immediately behind the internal meatus, and under the mucosa there is a small isolated adenoma. The prostate is otherwise normal. (*Ramon Guiteras* (*after Wallace*), *A Text-book of Urology, D. Appleton and Co.*)

that the gland tissue has almost completely disappeared and all that remains is a small mass of dense scar tissue. Symptoms of prostatism may occur, not as a result of the prostatic atrophy, but because the fibrous tissue has infiltrated the tissues surrounding the vesical orifice and the prostatic urethra, transforming the latter into a rigid, unyielding tube. This together with the lost suppleness of the sphincter mechanism of the bladder outlet imposes a heavy burden on the bladder walls, the effect of which brings, sooner or later, the picture of prostatism. The cause of the prostatic atrophy is the cause of the obstruction to urination; the atrophy *per se* is not, we believe, the important factor in causing urinary obstruction. In the fibrous variety, moreover, it is unusual to find pedunculated or sessile growths projecting from the surface of the prostate, these so-called prostatic tumors occurring almost without exception where the organ has undergone a glandular overgrowth.

These "prostatic tumors" are quite characteristic. In the prostate have been found at times true tumors, myomata, adenomata, and other growths; but what is understood by a prostatic tumor is a localized overgrowth of glandular acini, without increase in the number of the corresponding ducts. This acinous overgrowth compresses the sur-

Fig. 43.—A Section from Prostate No. 1502 (see Fig. 34) showing Considerable Hyperplasia and Some Dilatation of the Glandular Structures.

For the most part the lining epithelial cells are disposed in a single layer, but here and there are two or more layers, which, together with the mucoid infiltration of the cells and the periacinar round-cell infiltration, indicate catarrhal and other inflammatory alterations (×250).

rounding stroma into a capsular envelop, which it has been customary to regard as a myomatous growth, the prostatic tumors being denominated adenomyomata. Later investigations, however, have shown that this capsule is in reality composed of new connective-tissue elements. or fibroblasts, while the muscle tissue probably does not increase in quantity. In time the stroma surrounding these localized glandular outgrowths itself begins to grow, and may eventually, according to

Moullin, compress the pre-existent acini, so that the prostatic tumor formerly almost wholly glandular in character becomes eventually fibrous and solid. Moullin claims that increase in size, though less rapid, still continues during this which he calls the second stage of the pathological process. Whether or not we accept this view, that the fibrous is a subsequent stage of the glandular change, it is certain that the prostatic tumors, no matter what their state, are under considerable pressure from the surrounding stroma, and that they tend to grow in the direction of least resistance. This latter fact frequently causes them to project beneath the mucous membrane of the bladder, posterior to the urethral orifice. When seated within the substance of the gland, they are prone to start out of it on section, and may readily be enucleated with the finger, the few ducts from which the numerous new acini spring, unless they are included in the section, serving as their pedicle of attachment to the rest of the organ.

In some cases no such prostatic tumors are found, the gland presenting a nearly uniform, general enlargement, either glandular or fibrous in character; or a general glandular enlargement may exist in some areas, and a general fibrous enlargement in others. When this is the case, no nodulation of the surface occurs.

When a large part of the prostate becomes intravesical, it is usual to observe a constriction between this and the extravesical portion. This constriction is produced by the edges of the prostatic sheath, which as Mr. Freyer says, has been shouldered aside by the prostate in its efforts to expand beneath the mucous membrane of the bladder.

The internal vesical sphincter muscle also constitutes a line of separation between the intravesical and extravesical portions of the enlarged prostate. In a certain proportion of cases it leaves its imprint in the form of a groove on the enucleated mass.

During the last fifteen years, there seems to have been no particularly new ideas expressed on this subject. The consensus of opinion has shifted from time to time but there still remain two points which need emphasis:—first, the truly adenomatous origin of the glandular form does not seem to have been disproved, and second, great importance must be attached to chronic inflammation in the production of the fibrous form of prostatic enlargement.

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CHAPTER VI

CLINICAL PATHOLOGY: EFFECTS ON URETHRA, BLADDER, KIDNEYS, URINE, AND RECTUM

As the prostate gland enlarges, whether from tumor formation or as the result of a general hyperplastic process, various changes are produced in the urethra, the bladder, and the rectum; and less directly in the urine, the kidneys, and the general health.

Effects on Urethra.—The length of the urethra is almost always increased. Its normal length averages twenty centimetres, according to the extensive statistics compiled in 1898 by Keyes; but it varies from fifteen to twenty-five centimetres in health, and thus a length of over twenty centimetres may be no longer than normal for any individual patient; while, on the other hand, the urethra may be abnormally long by five centimetres when its length merely reaches the average. In drawing conclusions from such measurements the patient's height, his age, and the length of his penis, should all be borne in mind. The urethra is generally considered to increase slightly in length with advancing years, apart from any pathological change; and, other things being equal, the taller the patient, and the longer his penis, the greater may be expected to be the length of his urethra. The length of the penis, however, and consequently that of the urethra, varies so much in the same individual, according to the local temperature and nervous emotions on being examined, that this increase, unless marked, and accompanied by other symptoms, cannot be regarded as of very great importance.

When the subject of the physiology of urination was under discussion, we called attention to the now discarded theory of Finger. This theory held that the deep urethra becomes, physiologically, a part of the bladder cavity when the latter is distended with urine. It was then believed that as the bladder distends and the desire to urinate becomes increasingly insistent, the internal vesical sphincter muscle relaxes allowing the urine to flow into the deep urethra, whence its escape is prevented by the external sphincter and the compressor urethræ muscles. This theory was supported by the alleged demonstration of a shortening of the distance between the urethral meatus

and the urinary reservoir during distended states of the bladder. The difference between the length of catheter necessary to drain the urine from a comparatively empty bladder and a fully distended one was said to correspond to the normal length of the prostatic urethra.

FIG. 44.—ELEVATION OF VESICAL ORIFICE OF THE URETHRA AND FORMATION OF A RETRO-PROSTATIC POUCH.
Note the increased curve and length of the subpubic urethra.

We have failed to confirm this observation in a study of fifty normal cases, and could demonstrate only very slight differences in the urethral length. In a certain small percentage of prostatics the prostatic urethra does undoubtedly become a part of the bladder cavity but for pathologic rather than physiologic reasons. In case an adeno-

matous nodule enters the bladder cavity in such manner as to render ineffectual the sphincteric action of the muscle, the urine will find free access to the deep urethra where it may be retained by the external

FIG. 45.—LATERAL DEVIATION OF THE URETHRA TOWARDS THE PATIENT'S RIGHT, DUE TO OVERGROWTH OF THE LEFT LOBE OF THE PROSTATE.—(*After Anger.*)

group of sphincter muscles, or, as more often happens, the latter muscle will eventually fail and incontinence results; not infrequently there results an incontinence of retention. In these cases the prostatic

urethra has, to all intents and purposes, become a part of the bladder cavity, but the circumstance is a rare one.

The theory of Finger was finally and completely disproved when with cystographic studies it was possible to prove the entire absence

FIG. 46.—FORMATION OF A Y-SHAPED CHANNEL DUE TO THE PRESENCE OF A PEDUNCULATED "MEDIAN LOBE."

Several orifices of vesical pouches are also seen. A small concretion is attached to the "middle lobe."—(*After Cruveilhier.*)

of a "neck" to the bladder. In the majority of instances the urethra is elongated in cases of adenomatous enlargement of the prostate; in the fibroid cases on the contrary, and especially in the presence of fibrous bars at the vesical orifice, the length of the urethra may be

actually shortened through a diminution in the length of the prostatic urethra. The reason for this becomes at once evident when we examine the floor of the urethra in a case of this kind; the verumontanum, which normally occupies a mid-point on the floor of the prostatic portion of the canal, will be found lying just outside the vesical orifice and beneath the cleft-like edge of the bar.

In some of the adenomatous cases the length of the urethra may be increased up to thirty-five to forty centimetres; so that where urinary

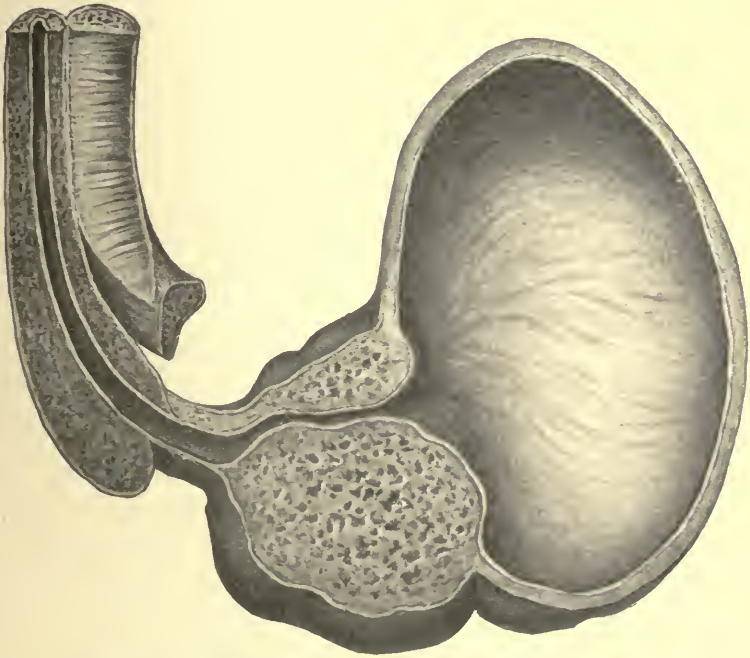

Fig. 47.—Overgrowth of Suburethral Portion of Prostate, Changing the Subpubic Curve of the Urethra.—(*After Anger.*)

retention is evident the surgeon must not be discouraged on failing to reach the bladder with the ordinary length of catheter.

This increase of length occurs chiefly in the prostatic portion, which may measure as much as ten centimetres. The bulbous urethra is also lengthened.

The means by which this increase in length is brought to pass may be explained by the fixation of the prostate gland at its apex, and the necessity which therefore exists for any enlargement to take place in a posterior direction. As will be remembered, in speaking of the relational anatomy of the prostate, attention was called to

the greater firmness of its attachment to the rectum, as compared with its superior relations; hence its greater enlargement is usually found extending into the floor of the bladder, this being a more compressible viscus than the rectum, which is so often filled with solid fecal matter, while the fluid contents of the bladder offer little resistance to prostatic encroachment. The enlargement upward of the prostate explains how in the enlarged organ the prostatic utricle comes to occupy the lower part of the prostatic urethra instead of its centre.

The fact that the neck of the bladder is thus encroached upon brings about a second change in the urethra, and this is in its direction. The vesical orifice of the urethra is thus raised from its normal situation, even where no isolated median enlargement exists; and the vesical half of the prostatic urethra may in extreme cases assume a right angle with its outer portion, so that the curve of the ordinary metal or English catheter will not fit the prostatic urethra, its point impinging upon the posterior wall. Besides a change in direction in the sagittal plane thus produced, there may be a lateral deviation of the urethra, due to unequal enlargement of the two lateral lobes, the channel being deflected towards the less enlarged lobe. Hence in passing a metal catheter in cases of obstruction from an enlarged prostate, if the beak of the instrument cannot be made to ride over the obstruction by depressing its handle, the surgeon should turn it first to one side and then to the other. If a pedunculated enlargement exists just back of the vesical orifice, a Y-shaped channel may be present, and the catheter will pass to either side of the median line.

By the same process by which the vesical orifice of the urethra is raised, the posterior or inferior wall of the prostatic urethra is much lengthened; and if no corresponding growth occurs in that portion of the prostate anterior to the urethra, and the anterior wall of the prostatic urethra remains unchanged, the diameter and consequently the capacity of the prostatic urethra may be much increased, so that it may hold thirty to sixty cc. of urine. Such extreme enlargement is, of course, rare; indeed, it more often happens that this portion of the canal is more or less compressed by the centripetal enlargement of the lateral lobes, so that on transverse section it appears as a vertical chink, instead of the normal crescentic outline. If this lateral compression is marked, and it is more apt to be so in cases of fibrous overgrowth than in adenomatous enlargement, total retention of urine may ensue, even though the vesical orifice of the urethra is not displaced, and the catheter enters with its usual facility; for while a catheter may easily

overcome very considerable lateral compression, the bladder will be unable to effect a like dilatation of the canal by hydrostatic pressure applied only to its vesical orifice. Instead of retention of urine being produced by the deformities of the urethra caused by enlargement of the prostate, true incontinence of urine—not merely retention with overflow—has occasionally been noted where the eccentric growth of the prostate keeps the urethral orifice constantly patulous.

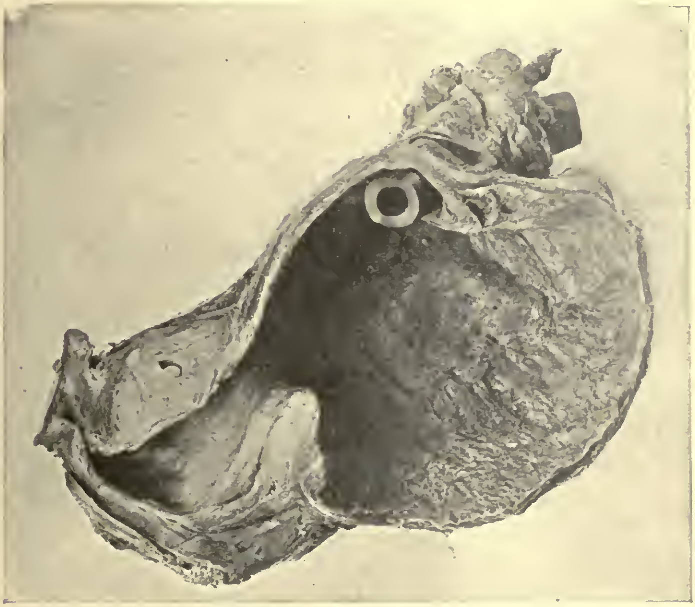

Fig. 48.—Hypertrophy of Lateral and Midlobes of Prostate, showing Antero-posterior Widening of the Urethra.
(*MacCallum, "A Text-book of Pathology."*)—*W. B. Saunders and Co.*, 1916.

If the parts below the urethra enlarge with greater rapidity towards its floor than towards the vesical trigone, the normal curve of the sub-pubic urethra may be obliterated, the canal here becoming straight; or its convexity may even be directed forward, towards the pubic symphysis. In such cases the catheter must be reversed before it will enter the bladder.

Vignard has shown that among twenty-eight specimens which he examined, in sixteen obstruction to urine existed throughout the whole prostatic urethra; in nine cases the obstruction was chiefly at the vesical orifice, but also to some extent in the urethra; while in only three out of the whole twenty-eight cases did it exist at the vesical orifice alone.

Besides the changes in length, direction, and size, to which the prostatic urethra is thus subject, it may be curiously distorted by submucous adenomata springing into its canal from any direction, most frequently from beneath its floor. Failure to remove such masses, palpable neither from within the bladder nor from the perineum, is the probable explanation of persistence of symptoms after many a prostatectomy.

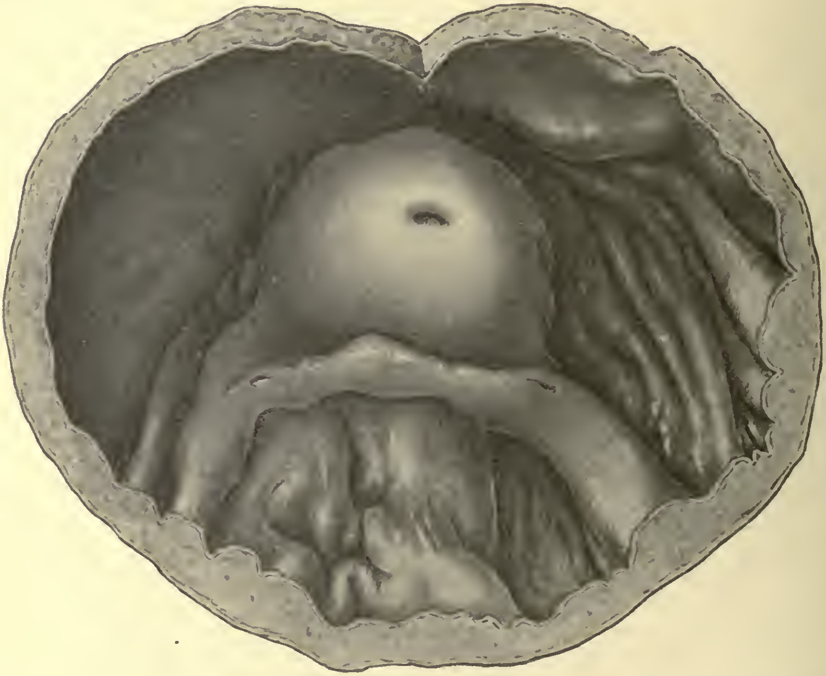

Fig. 49.—Collar-like or "Cervix Uteri" Enlargement of Prostate, seen from within the Bladder.—(*After Socin and Burckhardt.*)

The large submucous veins of the prostatic urethra become much engorged along with all other neighboring veins, and by a sudden access of congestion are the chief cause of attacks of acute retention of urine. They may bleed spontaneously at times, and even the most gentle catheterization may provoke considerable hemorrhage.

Effects on the Bladder.—Of all the changes produced in the bladder by enlargement of the prostate gland, none is of greater importance than the formation of a post-prostatic pouch, by the combined elevation of the urethral orifice and the descent of the vesical floor. This is a much more frequent cause of residual urine than is the ball-valve action of a pedunculated submucous adenoma blocking the urethra.

The descent of the vesical floor is the result, not the cause, as Mr. Harrison maintained, of the enlarged prostate. Where obstruction exists to the evacuation of a hollow viscus, it is surely always the preceding change, and the dilatation which is found arises from vain efforts to expel the contents. A familar example of this is seen in pyloric stenosis. If this obstruction is overcome, by gastroenterostomy or otherwise, the atonic stomach recovers its normal physiological action in the vast majority of instances. Similarly, if the urinary obstruction is removed, by excision or even by suprapubic drainage, the dilated and feeble bladder will recover, if the condition has been relieved in time.

FIG. 50.—CROSS SECTION OF ENLARGED PROSTATE.
Note the line of cleavage between the capsule *A*, *A*, and the glandular tissue. The urethra is displaced laterally as the result of greater involvement of one lobe. (*Pilcher, in Cabot's Urology.*)

The prostatic obstruction throws increased work on the bladder, as Mansell Moullin has well said, and when it is no longer able to empty itself, the floor, which is the part last to be emptied as well as the weakest, is the first to dilate. When this stage has been reached, every effort of the bladder for evacuation only serves to press the urine against its floor and to increase the capacity of the post-prostatic pouch.

The shape of the urethral outlet of the bladder may be variously

altered according to the part of the prostate most overgrown. (See Section on Cystoscopy). It is usually crescentic in outline, the concavity of the crescent being directed towards the most enlarged part. But if the prostate enlarges nearly equally in both its supra-urethral and infra-urethral portions, a collar-like projection will occur into the bladder all around the urethral orifice. This form of enlargement has been graphically compared, both in appearance and in feel, to the cervix of the uterus, the urethra being placed in the midst of a hillock, like the cervical canal between its lips.

If the lateral lobes enlarge uniformly and tend to spread away from the middle line, they are apt to raise a fold of tissue taut across the vesical orifice of the urethra. This fold may be composed of mucous membrane alone, or may have a varying amount of submucous tissue in it as well. It is one form of "bar at the neck of the bladder," and in many instances is a serious obstacle to catheterization.

As has been already remarked, an isolated adenomatous mass, springing from the prostate beneath the neck of the bladder just posterior to the urethral orifice, may cause the inner part of the urethra to become Y-shaped.

Very great impairment of the urinary function may result when there is no apparent mechanical obstruction. In such cases the cause of the trouble is the existence of a fibrosis in the neck of the bladder and the prostate. Such processes, the result of long preceding congestion or chronic inflammation, render the normally soft and pliable vesical outlet firm and rigid, so that the prostatic urethra can no longer open up into practical continuity with the bladder during urination; and as a consequence, obstruction arises from the immobility of the parts. In such cases the prostate may be little or not at all enlarged, but extremely hard; thus furnishing a marked example of the fibrous class.

While the most prominent changes in the bladder are thus seen to occur in the neighborhood of its neck and the trigone, certain alterations throughout its walls occur in many cases, and these are of nearly equal importance. They are partly the result of the effort to overcome the obstruction, and partly the result of the chronic cystitis which almost invariably accompanies prostatic enlargement.

The increased work thrown on the bladder causes first an hypertrophy of its muscular walls, which is manifest in the trabeculated appearance of its mucous surface. If the obstruction is not relieved in time, atony ensues, with dilatation of the bladder, or infective

interstitial cystitis and fibroid thickening of the bladder wall with diminution in the size of its cavity. In cases where the obstruction is unrelieved, chronic retention occurs, and the amount of residual urine gradually increases. The walls of the bladder may then become much

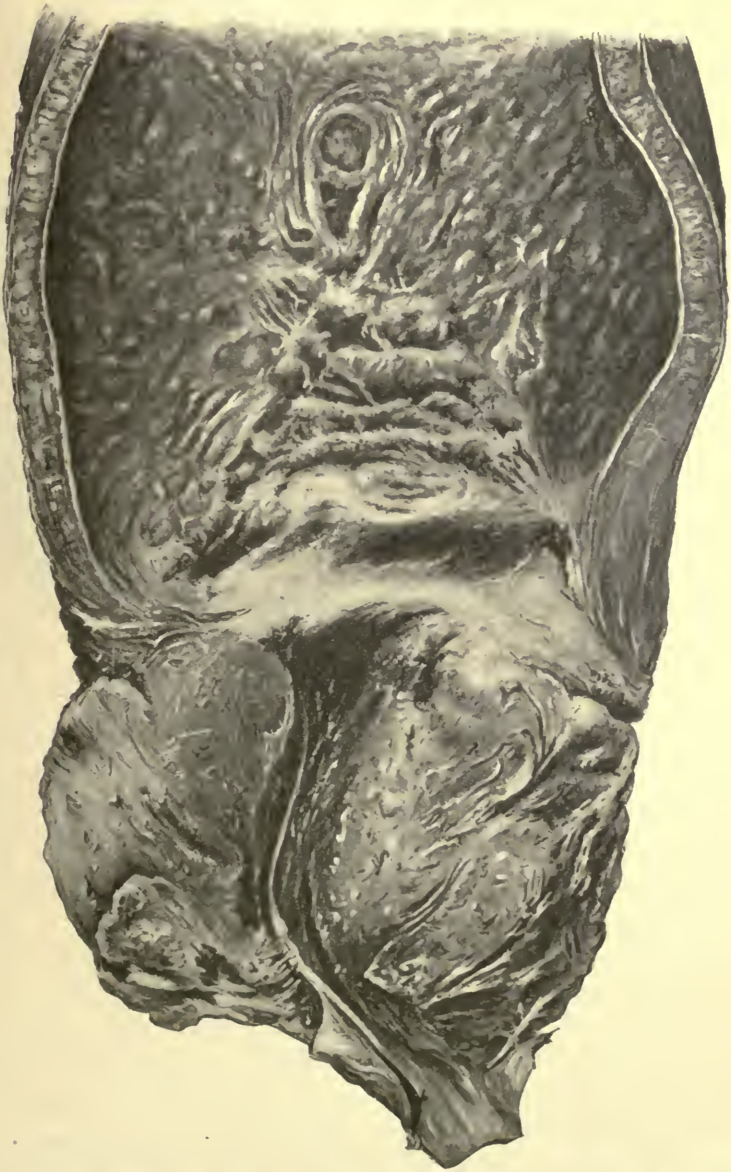

FIG. 51.—ENLARGEMENT OF THE LATERAL LOBES OF THE PROSTATE FORMING BETWEEN THEM A BAR AT THE NECK OF THE BLADDER.—(*Watson.*)

distended and extremely thin; and its fundus may reach to the umbilicus or above, before partial relief occurs from overflow. Atony of the bladder from actual disappearance of its muscular fibres through

FIG. 52.—ATONIC, DILATED BLADDER, FROM ENLARGEMENT OF THE PROSTATE WITHOUT MARKED CYSTITIS.

(From a specimen in the Mütter Museum of the College of Physicians of Philadelphia.)

fatty degeneration may thus arise; and although atony so extreme as to be irremediable is no longer thought to be very frequent, yet the surgeon should bear this danger in mind, and see that his patients are relieved of their retention before matters have gone too far.

But the bladder may not dilate; its walls may become much thickened, corrugated and pouched; its cavity may even contract, and contain only a few cc. of urine, necessitating its evacuation every ten to fifteen minutes. As the muscular walls become fibrous they contract on the contained mucous coat, and this may be seen bulging out in pouches in the interstices between the thickened fibrous bands, as efforts to expel the urine are made. These herniated pouches may in time remain permanently, not disappearing even when the bladder is relaxed. In such cases not only may residual urine collect in these pouches, but calculi may form in them, and thus much increase the pain and discomfort of the patient. The presence or absence of dverticulæ should be determined before attempting prostatectomy. Failure to discover the presence of a large diverticulum may lead to a most unfortunate outcome in the otherwise successful operative removal of an enlarged prostate. Owing to retention within the sac of the diverticulum the amount of residual urine is perhaps only slightly reduced after operation and the patient's symptoms are relieved only in part, if at all.

Careful search for the orifices of diverticula should be a part of the routine cystoscopic examination, or if this examination is for any reason omitted, it is advisable to prepare radiographs of the bladder. Finally, it is our custom at the time of suprapubic operations to make a careful inspection of the interior of the bladder.

The changes in the bladder walls the result of cystitis differ in no respect from those due to cystitis from other causes. Vesical catarrh is a prominent symptom, and the viscid ropy mucus adds to the urinary obstruction. The mucous membrane is highly congested; it may be ulcerated in places; and calcareous deposits are frequently found on its surface. So turgid are the veins that it is the rule for some degree of hematuria to be developed as soon as the dladder is relieved of the urinary pressure.

Where infection is present, it is probable that chronic urinary retention so extreme as to produce overflow never occurs; but that the acute pain and frequency of urination claim the surgeon's services at an earlier stage of the case. It is therefore in the infected cases that the small rugous and thickened bladders above referred to are oftenest encountered; and it may be considered a question whether the infection causes the contraction primarily, or whether this occurs only because the high grade of cystitis present makes relief to obstruction imperative before dilatation of the bladder has taken place.

Effects on the Kidneys and Ureters.—From the presence of residual

urine in any amount, changes may be observed in the orifices of the ureters. Normally these tubes enter the bladder wall obliquely, passing through the vesical coats for seven to ten mm.; and they discharge their contents into the bladder in driblets or in spurts at intervals of some seconds. But as the bladder becomes distended the ureteral openings are compressed, and the discharge of their contained urine becomes more difficult. When the bladder is excessively distended, and its wall is overstretched in all its parts, the ureteral orifices may become constantly patulous, by the approximation of their course through the bladder walls to a straight line. Dilatation of the ureters may result.

As soon as the pressure in the ureters becomes increased, a damming up of urine occurs into the pelvis and calices of the kidneys; and this change in pressure, apart from any infection, is soon manifested in the behavior of the kidneys themselves. Circulatory disturbances are produced in the kidneys, the immediate effects of which are not accurately known; but from the observations of Cabot it is evident that in their early stages they are not beyond the hope of cure. Generally speaking, it is pretty sure that this increased pressure alone, even without any infection, will cause the production of fibrous overgrowth in the kidneys, as well as an increase in the quantity and a decrease in the specific gravity of the urine excreted. That the primary change in the kidneys is probably atrophy of the secreting structure, while fibrous hyperplasia is a subsequent occurrence, has long been an accepted theory. The infective micro-organisms are usually carried to the kidney by the blood or by the lymph vascular systems, but direct extension upward beneath the mucosa of a dilated ureter or even by way of the lumen is, we believe, of common occurrence. The importance of renal complications is discussed at greater length in the section devoted to prognosis.

Where infection exists, and especially where the vesical orifices of the ureters are more or less patent, pyelitis and surgical kidneys soon develop.

Effects on the Urine.—The residual urine almost invariably becomes alkaline, and is a prolific cause of cystitis. Being alkaline, phosphatic or mulberry (oxalate of lime) calculi are prone to form. It has been estimated that nearly one-fourth of all patients with enlarged prostate have calculi as well. The calculus, however, being usually fixed rather firmly in the post-prostatic pouch, frequently gives no characteristic symptoms, and is difficult of detection with a sound. Especially is this the case where a calculus forms in or subsequently becomes lodged

FIG. 53.—CONTRACTED, INFECTED BLADDER, WITH THICKENED WALLS AND THE FORMATION OF VESICAL SACCULI, FROM ENLARGEMENT OF THE PROSTATE ACCOMPANIED BY MARKED CYSTITIS.
(From a specimen in the Mütter Museum of the College of Physicians of Philadelphia.)

in one of the pouches already alluded to; or when its surface becomes covered with mucus, or it is surrounded by prostatic overgrowths. As already mentioned, the urinary sâlts may be deposited in calcareous crusts over the entire vesical walls giving rise to encrusted cystitis.

When chronic cystitis develops, the urine presents the well-known characteristics of this disease. Shreds of mucus, pus, clots of blood, and various crystals may be found. Ammoniacal decomposition is frequent. The colon bacillus, imparting to the urine its characteristic odor, may be the infecting medium; it is not impossible for this germ to gain entrance to the bladder directly from the intestinal tract, though probably its more usual avenue of approach is through the urethra. Streptococci, staphylococci, and other micro-organisms are also found.

The pus, the mucus, and especially the blood clots, are frequent causes of stammering in micturition; and as they are sucked into the eye of the catheter impart to the hand a readily recognized sensation. The blood may come from spontaneous rupture of engorged veins, or from trauma by a calculus or a catheter. At times the clots are found nearly filling the cavity of the bladder.

When the kidneys become affected the urine becomes correspondingly altered, as seen in the early stages of interstitial nephritis from other causes. The quantity passed in twenty-four hours may reach 2700 to 3000 cc., or even more; the specific gravity will show a proportionate decrease; and albumen and tube casts may be detected. It should not be overlooked, however, that renal disease may have long antedated the prostatic trouble.

Effects on Urination.—Such widespread and serious changes throughout the urinary apparatus cannot fail to produce marked changes in the manner and the power of micturition. These will be more fully discussed under the heading of symptomatology, but it is well to recall briefly in this place the *modus operandi:* Residual urine causes cystitis; cystitis causes frequent desire for urination; frequent urination increases the existing congestion; this in turn may bring on retention of urine; catheterization is resorted to, once or oftener; infection is very liable to occur in a bladder already so inflamed; the retention and the infection of the urine produce circulatory disturbances in the kidney; the quantity of the urine is increased, and a vicious circle is established, which, unless the primary cause, urinary obstruction, be removed, will quickly affect the patient's general health.

The dilatation of the bladder, and consequent weakness of its

walls, causes two well-known symptoms—feeble power of expulsion, and slowness in completing the urinary act; while finally the inability of the vesical neck to act properly, and the interference with the muscles around the membranous urethra, cause the last portion of urine to be voided in dribbles, no power remaining of evacuating it in spurts.

Effects on the Rectum.—Enlargement of the prostate, as is well known, is very apt to be accompanied by hemorrhoids and prolapsus ani. These affections may be produced by the prostatic hypertrophy, or they may be due to an independent though concurrent cause.

Venous engorgement of the prostate and the vesical neck is one of the main causes of sudden urinary retention, as mentioned above; and such venous engorgement, when prolonged or when recurring frequently, soon leads to a varicose condition of the prostatic plexus. Under these conditions incompetency of the valves in this plexus develops, and the blood regurgitates through communicating branches, and becomes dammed up in the internal pudic and the middle and inferior hemorrhoidal veins. Since all these, as well as the prostatic plexus itself, empty into the internal iliac vein, no real relief to the venous obstruction ensues; but hemorrhoids develop, and by their pain add to the misery of the patient. Some slight relief might occur from vascular overflow into the superior hemorrhoidal veins; but as these are radicles of the portal system, which has no valves, and which is very apt to be already congested or obstructed in persons who have reached the prostatic age, the superior hemorrhoidal veins are only too often varicose even before the middle and inferior become so. Phleboliths are common in the prostatic plexus.

Not only does prostatic enlargement affect the rectum in this manner by producing hemorrhoids, but it may seriously obstruct the rectal canal when the gland is much enlarged in this direction. The act of defecation is rendered difficult and painful by this enlargement; constipation is favored, and this again reacts for evil by increasing the tendency to piles.

Prolapsus is liable to follow in the wake of these other troubles, both from the straining in the efforts to empty the bladder. and from the hemorrhoidal condition of the rectum itself.

Pelvic congestion is favored by nearly every circumstance —especially by the condition of the patient's heart, kidneys, and liver, all of which have, as a rule, begun to show the fibrosis of age; as well as by the prostatic changes produced by whatever cause.

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CHAPTER VII

SYMPTOMS: SUBJECTIVE AND OBJECTIVE

Subjective Symptoms.—Not every patient with enlargement of the prostate presents symptoms of his malady. Only about one in every seven who has an enlarged prostate suffers from it; and even among the number who do develop symptoms there are many in whom these begin so insidiously that the patients will perhaps be unaware of any deviation from the normal until acute retention of urine occurs from some access of obstruction, or until overflow relieves the unperceived chronic retention. The affection, on the other hand, while gradual in onset, may yet make its presence felt by symptoms which arrest the patient's attention from the first.

Some change in the urinary function is almost invariably the earliest change, and usually consists in an increased frequency of micturition. This, if it occurred only during the day, might easily escape notice; but since it is present at night as well, and compels the patient to arise once or oftener from his sleep, is a change which is very soon observed, and for which an explanation is usually promptly sought. Especially with younger patients is this true; among the old a not unnatural idea exists that frequency of urination is one of the signs of age, and is therefore rather to be anticipated.

Frequency of urination is due mainly to two causes: first and foremost, because the congestion or inflammation of the vesical neck and the parts around the prostate renders the bladder more sensitive to the presence of urine, and hence less able to support a large volume of fluid; and, secondly, because residual urine lessens the capacity of the bladder, which as a consequence reaches its usual grade of distention at shorter intervals. Besides these factors, the quality of the urine is often exceedingly irritating, and so its expulsion is demanded more frequently.

Many authors have taught that the frequency of urination is greater at night than during the day; but, apart from the lack of reason for this phenomenon, we doubt its being a fact. Greater stress is laid upon nocturnal frequency by the patient, and consequently in many cases by the surgeon. merely because it arrests the attention

sooner than increased frequency of urination by day. A man may wash his hands eight or ten times during the day, and think nothing of

FIG. 54.—DILATATION OF THE URETERS AND HYDRONEPHROSIS FROM LONG-STANDING PROSTATIC OBSTRUCTION.
(From a specimen in the Museum of the Pennsylvania Hospital.)

it; but if he awakes during the night with an irresistible desire to get up and wash his hands, he would be very sure to remember the fact

in the morning, and to seek an explanation. This is an extreme comparison, but serves to show why more importance is attached to nocturnal frequency, than to that occurring during the day. These patients are not inclined to urinate oftener while recumbent in day-time, so the horizontal position cannot be given as a cause for greater frequency by night. Sleep may possibly be the factor of greatest importance, by lessening the power of inhibition over the involuntary sphincter, and by unconsciously increasing the resistance of the voluntary sphincter: thus when the patient finally wakes, his bladder is fuller, because a longer interval has elapsed since it was last emptied, than is the case during the day; and after this first sound sleep of a few hours, the bladder has been rendered so irritable by overdistention that calls to urinate occur with greater frequency during the remainder of the night. This is given as a possible explanation by Moullin; and it appears to be a fact that the first interval at night is the longest. Other explanations of nocturnal frequency have been given, such as sexual emotions during sleep; but it is probable that these are as much a consequence as a cause.

Of course, when cystitis develops this of itself causes the desire for urination to be more frequent; and where ulceration or fissure of the bladder exists, the vesical tenesmus may be constant and uncontrollable.

The patient is likewise unable to expel the urine with his accustomed force. *Starting the stream is difficult*, much straining being required, because there is both increased obstruction and decreased expulsive power. When started, the stream does not spurt forth in the normal parabolic curve, but tends to *drop vertically from the meatus*. A longer time than usual is required to pass the urine, although a smaller quantity than normal is passed, since the intervals are less and some residual urine remains. The stream is not smaller than in health, unless stricture causes it to be so.

As the act of urination draws to a close, *the urine dribbles involuntarily*. It will thus often wet the patient's shoes; so that if there is much sediment present, these spots on drying will be incrusted with salt; from this fact alone a tentative diagnosis may be made. The cause of the dribbling, without the power being present of evacuating the last drops in spurts, probably lies in the impaired contractility of the bladder, which fails to send forward into the membranous and the bulbous urethra a sufficient quantity of urine for the voluntary muscles to contract upon. The prostatic urethra, moreover, is unable to

put itself into physiological continuity with the bladder, and acting as a more or less rigid tube, interferes with the normal flow.

Intermittent urination has been described as present in some cases, but is very rare. It may be due to the ball-valve action of a prostatic outgrowth, which is more tightly forced against the vesical outlet the more forcefully the bladder contracts, and which permits urination only when it is floated back from the orifice of the urethra, during intervals of straining. If not due to such a cause as this, the ordinary "stammering with the urinary organs," as Sir James Paget termed it, affords a sufficient explanation. The presence of a calculus may also act in this way.

Retention of urine is observed by the patient only when acute, or when the chronic form is accompanied by overflow. By far the most frequent cause of acute retention in these cases is an access of congestion in the vesical neck. A man who very likely had thought himself previously perfectly healthy will attend some pleasure party, eat and perhaps drink more than he is in the habit of doing, be exposed to draughts, become overheated, or in some way commit an indiscretion; and on his return home will find himself unable to pass his urine. When relieved by catheterization, a similar event may not occur for months or years, or perhaps never again.

Overflow from retention is in some instances the symptom which first attracts the patient's attention. When the bladder has reached its limit of distensibility, as soon as any urine is received from the ureters, an equal amount must be discharged by the urethra. This involuntary leakage may be noticeable first only at night, when the influence of the will is withdrawn, or by day only during the effort of lifting some heavy object, in stooping to pick something from the floor, or during defecation—all these acts necessitating contraction of the abdominal muscles, and hence diminution in bladder capacity. At later stages this overflow becomes a constant symptom, and unless relieved the patient must wear a urinal, or have his clothing constantly wet. The odor attendant upon this condition will frequently, in the poorer class of patients, at once direct attention to the true state of affairs.

As previously pointed out, this symptom is much more frequent where there is no cystitis. The probable explanation is that no catheter has ever been passed to relieve the bladder of its residual urine, and to prevent its walls from losing their muscular tone through overdistention; and that since no catheter has been passed, no cystitis has developed.

Incontinence of urine is extremely unusual. It has often been supposed to be present when the true condition was that just described—overflow from retention. If true incontinence of urine does exist, it may readily be determined by catheterization, when the bladder will be found empty. It is probably due, when present, to a form of prostatic overgrowth which keeps the vesical orifice of the urethra constantly patent, and to inability of the voluntary sphincter properly to contract. In the abnormal condition where urine is constantly in the prostatic portion of the urethra, a constant effort of the will is required to avoid its passage. Hence, even if the voluntary sphincter can act normally during the day-time, incontinence will be present in these cases during sleep, except where the elastic resistance of the urethra is stronger than the contraction of the bladder walls. But, as a rule, when true incontinence occurs at all, it is present throughout the twenty-four hours.

The symptoms of *cystitis* arising in a patient with enlarged prostate are the same as those in other cases of cystitis, and do not require extended mention in a work of this kind. Cystitis in these cases is usually caused by catheterization. It is possible for bacteria to gain entrance to the bladder in other ways, such as through the kidneys, directly from the rectum, and by extension along the urethra.

Urination which was frequent before, becomes doubly so when cystitis develops; tenesmus is more pronounced, and the relief obtained by the partial evacuation is slight. A heaviness and burning may be felt in the perineum; suprapubic pain may be marked; or the most infernal of all tortures, the burning, boring, uncontrollable pain in the neck of the bladder, may render the patient nearly insane. Pus, mucus, and blood may all be observed in his urine.

Hematuria, though not one of the most prominent symptoms, is met with sufficiently often to command the surgeon's particular attention. It may be due to spontaneous rupture of varicose urethral or vesical veins, or it may be produced in certain instances by the most gentle catheterization, or it may come from ulceration due to prolonged cystitis or to calculus. In cases of marked obstruction the patient after persistent straining may relieve himself of only a few drops of blood. In such cases the blood probably comes from congested veins. If the blood is mixed with the urine as it flows, it probably comes from the prostate or from the neck of the bladder, and may flow from an ulcer or from a ruptured blood vessel. If it flows only at the close of urination, and particularly if it is clotted, it is apt to come from the post-prostatic pouch of the bladder.

Symptoms of renal failure my arise at various stages of the disease. Nephritis may, of course, be an independent affection; but if not already present, is usually manifest very soon after the quantity of residual urine becomes great, or when infection of the bladder causes retrograde pyelitis. The patient may notice that he not only passes urine more frequently, but that the total quantity passed is greater, and that he is unaccountably thirsty. This increase in quantity is one of the earliest evidences of impairment of the kidneys, and should be carefully noted. If complete retention occurs in such cases, uremia may rapidly supervene, from the inability of the kidneys in their diseased state to excrete under increased pressure the toxic matters whose retention in the blood gives rise to the well-known symptoms: confusion and anxiety of mind, dyspnœa, dry burning skin, feverish eye, parched tongue, urinous odor to the breath, hiccough and vomiting, somnolence and coma, convulsions, and death. If pyelitis is present from infection, irregularly recurring chills, with fever and sweats, may be added to the above train of symptoms.

Closely following upon the heels of renal involvement, certain *cardiac symptoms* may appear—slight dropsy in the ankles or the hands, shortness of breath on exertion; palpitation; loss of appetite from gastric congestion; and other symptoms too generally recognized to need repetition here.

Sexual power is often lost if the prostatic disease is far advanced; in earlier stages intercourse may be painful, pain being marked especially after completion of the act. Not infrequently the sexual appetite is abnormally active, and distressing priapism may occur.

If the prostate enlarges much towards the rectum, certain additional symptoms may be noted by the patient. Both *constipation* and *obstipation* may arise; and the constant straining to urinate or defecate may produce hemorrhoids, and even *prolapsus ani*, as in the case of children straining on account of vesical calculus. It is in this form of enlargement, too, that the fullness and uncomfortable feeling in the perineum, so often complained of, are chiefly found.

If *calculi* form in the bladder, some special symptoms of this malady may be noted; but, as a rule, they are subordinated to the peculiar prostatic symptoms, since the stone is held fairly firmly in the post-prostatic pouch, or in the sac of a diverticulum.

To attempt clinical pictures of patients suffering from enlargement of the prostate, by dividing the disease into certain stages, is a rather arduous task, since the duration of any one symptom or set of symptoms

varies exceedingly in different individuals. Perhaps as just an appreciation as any of this view of prostatic enlargement may be reached by grouping the patients into three classes, in the first of which, the earliest stage, may be placed those patients whose chief complaint is nocturnal frequency of urination; in the second stage those patients who suffer occasionally from complete retention, but whose cystitis is insignificant, and whose general health is fairly good; and in the third class those wretched individuals whose retention is nearly absolute or quite so, who depend entirely on catheterization, whose kidneys are markedly diseased, and whose general health is on the verge of collapse.

Some patients will remain in the first stage all their lives; some will within a few months pass into the second stage; and others will seemingly jump at once from the first to the third stage with scarcely an appreciable sojourn in the second.

Some patients, on the other hand, will never be conscious of having passed through the first stage, but will first be impelled to seek medical aid for sudden retention of urine; and may then, if fortunate, return to the first stage and remain there all their lives. In many instances patients who reach the second stage without having been aware of the first will remain in the second stage throughout their lives; but in very rare instances only do patients pass at once from a life of seemingly perfect health to one of absolute and complete catheterism.

The surgeon should, above all things, bear in mind that a positive diagnosis of enlargement of the prostate can never be made from the symptoms alone: a physical examination is absolutely essential.

Objective Symptoms—Physical Examination.—When a patient, suspected from the symptoms he describes to be suffering from enlargement of the prostate gland, presents himself to the surgeon, the first and most important physical sign to be looked for is the presence of a hypogastric tumor, with the characteristics of a distended bladder. Important as it is in all cases, it is above all in those patients who have been afflicted with chronic urinary retention and over-flow that this precaution is indispensable. In such patients the hasty introduction of a catheter may cause immediate syncope, from the decrease of intra-abdominal pressure, and may in a few days lead to death from renal congestion and uremia. To plunge a catheter regardlessly into such a bladder in one's office, or at a hospital dispensary, where the patients are not provided with the requisite facilities for proper after-treatment, will ever remain a most dangerous and unsurgical procedure.

Having detected such a hypogastric tumor, or having ascertained

its absence, the patient should next be requested to urinate. We may then observe the facility, or the difficulty, with which he starts the stream; the force with which it is expelled from the bladder; its size, as indicative of stricture or not; whether it is suddenly interrupted at any time, showing the possible ball-valve action of a pedunculated "middle lobe," or of a calculus; and whether he concludes the urinary act in the normal manner, or if the last portions dribble out of his urethra without voluntary control. From a strict attention to these details—and no details are too insignificant in urinary affections—much may be learned that will prove of subsequent interest. The quantity of the urine thus passed is then to be measured, and a portion of it preserved for chemical and microscopical examination. Its color, odor, and the presence or absence of sediment, as roughly gauged by the eye, will be of immediate use to us in approximating the condition of the bladder and the kidneys. By learning the interval since the last urination, and knowing the quantity just passed, we may form an estimate of the total quantity passed in twenty-four hours; and if the amount of residual urine is fairly constant, this quantity serves as a rough index to the action of the kidneys. If a patient passes 120 cc. of urine only every three or four hours, either the normal amount is not excreted by the kidneys, or else the quantity of residual urine is rapidly increasing. If, on the other hand, from fifteen to thirty cc. is passed every ten or fifteen minutes, the patient's kidneys will be excreting from 150 to 4500 cc. of urine daily, and retention with overflow probably exists.

If it appears that the bladder is not distended, it will then be proper and convenient to insert a catheter to determine the amount of the residual urine, and to aid in palpation of the prostate. For these manipulations the patient should be in the horizontal position.

In many cases the surgeon will be forced to try several catheters before he succeeds in reaching the bladder. Where possible, for diagnostic purposes only, we prefer a bicoudé catheter, about number twenty of the French scale. For the first examination metal instruments present many obvious advantages, such as the ease with which they are sterilized by being passed through the flame of an alcohol lamp, or by igniting alcohol which has been poured over them; and finally, what is of great importance, that they serve as an exploratory sound both in the urethra and within the bladder. We have little doubt that many a soft-rubber catheter which is sterile when taken into the hands, oftentimes becomes foully contaminated by the manipulations

that are necessary for its insertion into and passage through the urethra. In the small group of cases in which cystoscopic examination is for any reason inadvisable, we, therefore, prefer to make the urethral exploration for diagnostic purposes with a metal instrument.

As the catheter passes, the surgeon should note the presence or absence of strictures, any deviation from the normal line of the subpubic urethra, the height to which its vesical orifice is raised, and lastly the distance from the urinary meatus at which urine first begins to flow.

In passing the catheter the following facts favor the diagnosis of enlarged prostate: If it is found that the shaft has to be unduly depressed between the patient's legs before any urine flows, showing that the vesical orifice of the urethra is raised; if the urinary distance (that from the meatus to the point at which urine commences to flow through the catheter) is increased above twenty centimetres; if the catheter deviates towards one or the other side as it passes through the prostatic urethra, showing an inequality in size of the two lateral lobes, or, finally, if an obstruction to the passage of the catheter is encountered at a distance of more than about seventeen centimetres from the meatus, showing that the obstruction is not due to strictures, which are never present in the prostatic urethra.

The surgeon should not be deceived into thinking the bladder has been reached when a small quantity of urine is evacuated from an enlarged prostatic urethra. It will be remembered that this portion of the urethra may at times hold as much as thirty to sixty cc. of urine.

The bladder having been reached with the catheter, the residual urine will flow. If it flows through the catheter without effort on the patient's part, it indicates a fairly good vesical tone; but if even with the aid of his abdominal muscles the patient cannot expel the residual urine, and only by suprapubic pressure with the surgeon's hand can this be made to flow, it is evident that atony of the bladder is far advanced.

The amount and the character of the residual urine will then be noted. From it much more accurately than from that passed voluntarily can the state of the bladder be inferred. Some sediment will almost invariably be evacuated. If much is present, it is probable that catheterization has often been resorted to before, and that a more or less marked cystitis exists. Clots of blood are frequently found. Possibly some calcareous sediment will exist. The odor of the residual urine is usually ammoniacal. But apart

from the fact of there being residual urine, its quality does not aid the diagnosis of enlarged prostate, merely showing the grade of cystitis present.

It is well to inject a few cc. of warm boric acid or saline solution, to hold the walls of the bladder away from the beak of the catheter. By the resistance encountered during the injection an idea of the condition of the bladder walls—whether dilated or contracted—can be obtained.

Using the metallic catheter with all gentleness, then, as a sound, we can detect the approximate amount of intravesical enlargement of the prostate; the quality of the bladder walls, whether flabby and dilated, or thick, rugous, and pouched; the existence of calcareous crusts on the surface of the bladder, and of a calculus in the post-prostatic pouch, or in one of the vesical sacculi.

The surgeon should next, without removing the catheter, introduce a finger of the left hand into the patient's rectum. In doing this it is usually more convenient to stand on the patient's left side, and to manipulate the catheter or the sound with the right hand. The intravesical instrument is to be regarded merely as a very long finger, and the amount of information that can be gained through it by an experienced surgeon will be a matter of astonishment to the tyro.

The examining finger should not be thrust blindly and suddenly into the rectum—such a procedure is both painful and dangerous, since hemorrhoids with considerable proctitis may be present; but by a very gradual and gentle boring motion the finger may be insinuated so as to cause the patient very little discomfort. As the finger passes the sphincter we can feel the catheter in the bulbous urethra, then can trace it back into the membranous urethra, but in case the prostate is enlarged it will be impossible to trace it further. The finger next encounters the prostate in the anterior rectal wall, and, passing to either side, towards the ischial tuberosities, the outline of the enlarged lateral lobes can be detected. In most cases it will require a long finger to reach well beyond the enlarged prostate, and to feel the tip of the catheter in the retro-prostatic pouch; but this should always be attempted, as we thus obtain a very much more accurate idea of the size and shape of the prostate; and where the beak of the catheter is not long enough to reach the floor of the pouch, it may be possible to elevate this by the finger in the rectum, and thus to detect a calculus which might otherwise have escaped notice. By directing the patient to close his mouth and "bear down," the prostate may be forced into reach of the finger even when very much enlarged.

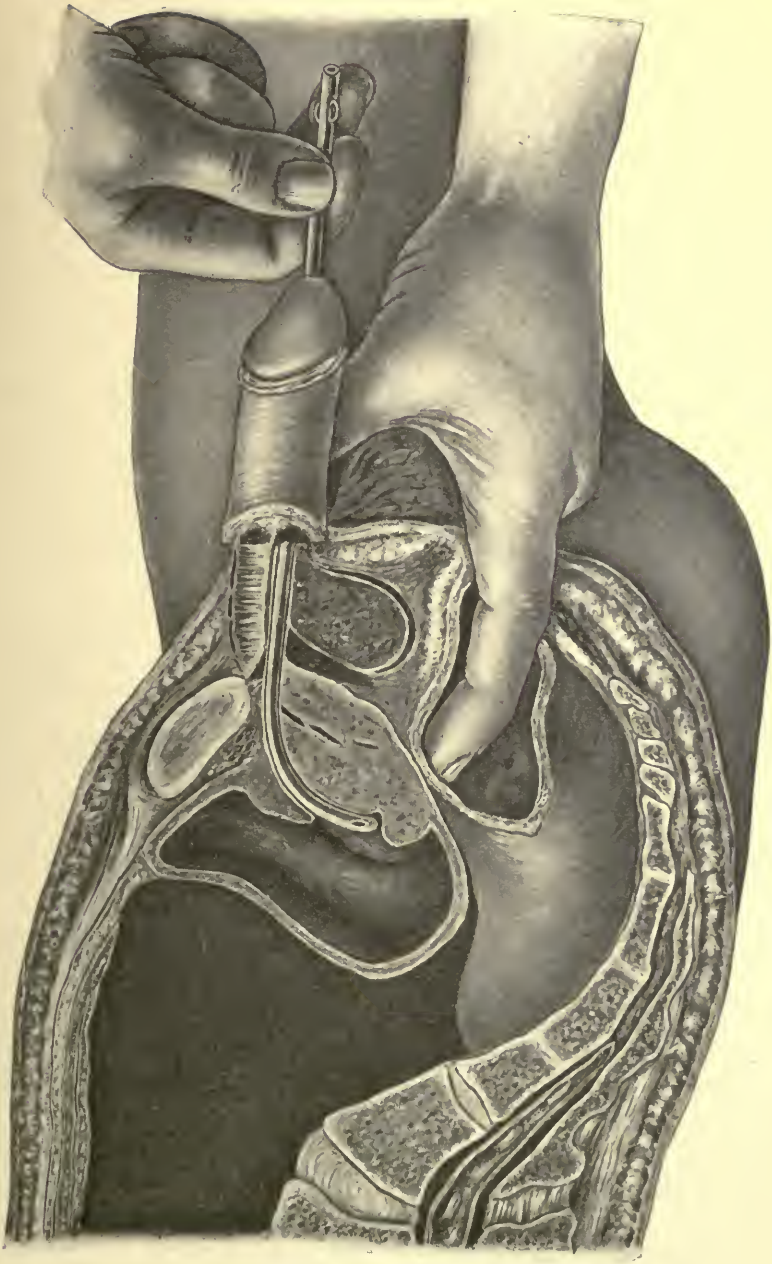

Fig. 55.—Combined Examination, with a Catheter in the Bladder, and a Finger in the Rectum.

Before withdrawing the finger the state of the seminal vesicles should be examined if they are within reach. The existence of high internal hemorrhoids can also be determined.

If it has been impossible satisfactorily to examine the rectal relations of the prostate on account of its size or its high position in the pelvis, an assistant may be able, by well regulated but firm suprapubic pressure, to bring it within reach of the palpating finger; or it may be gently drawn down by the aid of the catheter within the bladder.

Such an examination as this will usually enable us to say whether or not the prostate is enlarged. The surgeon should remember, however, that many symptoms of enlargement of the prostate may exist without any enlargement being present; and that enlargement of the prostate may exist and yet give rise to no symptoms; and, furthermore, that even where characteristic symptoms and prostatic enlargement are both found, one is not necessarily caused by the other. Hence no surgeon should undertake any plan of treatment hastily, or without due consideration in cases of this kind. Indeed, it is often best to temporize for awhile, until by making repeated and careful examinations all possible sources of error have been eliminated, and the condition of the parts involved has become familiar to the surgeon.

In the local examination such as has been described, it has been assumed that the urethra was freely open to instrumentation; but in very many patients this is not the case: strictures, false passages, and obstruction by the prostate itself may render such an examination impossible; and hence oftentimes the best that can be done is to improve the condition of the urethra, and so persist until a satisfactory examination finally becomes possible. Enlargement of the prostate is not a disease in which haste is advisable. Most of the foregoing procedures have today been discarded in favor of the cystoscope, the use of which in cases of prostatic hypertrophy is described elsewhere. There are, however, cases in which cystoscopic examination is impossible or impracticable and in this group recourse may well be had to the measures described above.

Besides the condition of the urinary tract, the surgeon should always make a thorough general physical examination. The signs of age, whether premature or not, should be sought for: the condition of the arteries, the arcus senilis, the cardiac action, and the general circulation all require attention. The general health should be determined—the appetite, the habits as to smoking and drinking, the digestion, the amount of sleep usually obtained, and the ability to

pursue the usual occupation—none of these should be neglected. The state of the heart and the kidneys is of the utmost importance: increased renal pressure and the consequent toxemia soon make their presence known by cardiac hypertrophy, with increase in size of the left ventricle, evidenced by displacement of the apex-beat downwards and to the left, and by the stronger and longer first cardiac sound in the same situation, with the well-known accentuated second aortic sound; so that any surgeon who pretends to accuracy in diagnosis would be guilty of great oversight if he neglected a careful examination of the heart. Of even greater importance than the detection of cardiac hypertrophy, is it to discover the early signs of dilatation of the heart. It is probable that the accentuation of the second aortic sound, above referred to, is not an early sign of hypertrophy, so that where it has existed for some time, the evidences of dilatation may be shortly expected; here the weakening of the first apical sound, with the production of a mitral systolic murmur, and increase of cardiac area to the right of the sternum, with perhaps occasional murmurs of incompetency over the aortic valves, we regard as the most valuable local signs. But as further evidence of cardiac dilatation we would call special attention to the various results of venous congestion, such as dyspnœa, œdema of the extremities, varicose veins, hemorrhoids, hepatic and gastric congestion, loss of appetite, and flatulency with indigestion.

The functional capacity of the kidneys must be ascertained before any operation is attempted for the relief of chronic urinary obstruction. The various tests employed in this determination are described in the chapter devoted to diagnosis.

An examination of the blood will be of interest; though it cannot be expected to aid in the diagnosis. The percentage of hemoglobin is the most important point to be determined, since by it we gain a fairly accurate index of the patient's ability to withstand operative treatment. The coagulation time of the blood should be determined for obvious reasons.

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CHAPTER VIII

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS; CYSTOSCOPIC DIAGNOSIS; KIDNEY FUNCTIONAL TESTS

The diagnosis of prostatic enlargement is usually not difficult. In the first place, the clinical history, or the sequence of symptoms, is almost invariably characteristic. Increased frequency of urination, in a patient past the prime of life, will at once direct our attention to the prostate. Retention may have necessitated the passage of a catheter once or oftener. If the retention has been due to strictures, the patient will usually be quite well aware of the fact, and will be more inclined to confess their presence than perhaps a younger man who may have the memory of their onset and early stages more vividly in his mind, and may regard them as more of a reproach.

Many of these patients will have been under treatment by another practitioner, and will know their own malady well, so that frequently the surgeon has only to confirm a diagnosis already made. But it is well not to forget that the physician, no matter how high his reputation, may have erred in his diagnosis, and that therefore in enlarged prostate as in other affections it is safe not to take a ready-made diagnosis.

As a rule, the age of the patient and his nocturnal frequency of urination are sufficient to arouse suspicion. As has been already mentioned, the general aspect of the patient, together with a urinous odor, due to overflow from retention causing his clothing to be more or less constantly wet, will in some instances enable the acute observer to anticipate the diagnosis even before the patient states his troubles. Even in cases seemingly obscure at first, a detailed history of the case and a complete and strictly systematic physical examination will invariably enable a correct diagnosis to be made. It is only where small or impassable strictures prevent instrumental examination of the vesical surface of the prostate that a diagnosis becomes at times impossible, unless sufficient enlargement can be felt by the rectum to render an intravesical examination superfluous.

The stage of the disease is usually more easily determined from the symptoms than from the physical examination. The most important

change in the life-history of these patients is that produced by cystitis, which unfortunately is nearly certain to make its appearance sooner or later. Naturally, the earlier the stage at which prostatics are first seen, the greater is the hope of cure. When the urine is constantly of a specific gravity below 1.010, the action of the kidneys is manifestly impaired, and the disease may be considered quite far advanced. The symptomatology of prostatic disease is dependant upon the size of the prostate, the degree of obstruction to the urethra to which it has given rise, and to complications, of which the most important are cystitis, vesical calculus, and infections of the kidney and the renal pelvis. But from the operative standpoint, and indeed from the standpoint of prognosis, the symptoms are of comparatively little importance. Thus a patient who is suffering very slightly may prove to be a very poor operative risk on account of grave disturbances of renal function. The diagnosis of prostatic obstruction entails therefore, not only the determination of the presence of an enlarged prostate gland, but of the local and systemic complications as well. In this chapter we will describe the clinical, instrumental, and laboratory means of diagnosing prostatic enlargement and of differentiating it from those conditions which may give rise at times, to similar symptoms. The longer infection is absent, the longer is the disease apt to endure in a quiescent state, the patient being troubled mainly with frequency of urination until the accumulation of residual urine produces overflow.

The cardinal principle by which we determine the size of any body is by learning the distance between its surfaces, or its diameter; to accomplish this in the case of an organ situated as is the prostate, it is absolutely essential to gain entrance to the bladder above and to the rectum below. It is not sufficient merely to insert a finger into the rectum and to palpate the prostate; nor is it enough to learn by catheterization that the urinary distance is increased, that the subpubic urethra deviates from the normal curve, and that there is residual urine. By the rectal touch frequently no enlargement can be detected while decided urinary obstruction exists from overgrowth into the bladder or the urethra; and the information gained from the passage of a catheter alone is manifestly incomplete. Hence before making a positive diagnosis the surgeon should resort to the combined examination with a sound or catheter within the bladder, and a finger in the rectum, and with few exceptions to cystoscopic examinations.

But merely to ascertain that the bulk of the prostate gland is increased is not to make sure the diagnosis of "enlargement of the

prostate." Enlargement may exist from various morbid processes, such as chronic prostatitis, prostatic abscess, calculus, or tumors of the prostate; and it is chiefly by attention to the clinical history of the case that a distinction between these different forms of enlargement is reached, although, as will be mentioned under the head of differential diagnosis, the sense of touch will aid us here as well.

It is an important thing to be able to distinguish between the two main classes of prostatic overgrowth—the glandular and the fibrous—since the same operation, if one is indicated, is not usually advisable for both varieties.

The prostate which has undergone a change which is chiefly adenomatous in character is larger and less dense than the normal organ, and is usually not firmly fixed, unless its great size makes it so; the rectal mucous membrane glides easily over its surface; the general outline of the two lobes and the intervening commissure can often be distinguished; and well-defined adenomatous masses (prostatic tumors) of greater than the normal density may at times be palpable in the substance of the gland; while the surface may present similar protuberances, sessile or pedunculated.

The bladder in such cases is more apt to be dilated than contracted; cystitis is either slight or absent; and the patient may reach the stage of retention with overflow before he has observed any marked deviation from his usual health. The duration of the malady and of the urinary frequency will usually have been several years at the least.

Where the fibrous prostate has developed, the organ will be but slightly enlarged, or may in rare instances even become smaller than the normal. Its density is increased; periprostatitis, as a rule, has occurred, causing the formation of fibrous tissue about the prostate, so that it is less movable than normal; the rectal mucous membrane will be less able to glide over the surface of the altered gland; and the outlines of the prostate will be more difficult to determine. No protuberances are, as a rule, to be felt on its surface, and so dense is its whole substance that embedded tumors, if present, cannot be detected.

The bladder, in the case of the fibrous prostate, has probably early been exposed to infection: it is found contracted, its walls thickened, and its surface perhaps pouched. As a consequence, distressing symptoms have made themselves prominent early in the case; and the patient may give a history of only a few months' or a year's duration; while he rarely, if ever, reaches the stage of overflow, as the constantly

recurring desire for urination has impelled him to keep his bladder nearly empty, by catheterization or otherwise.

It is the contemplation of these two clinical pictures—the one a dilated and passive bladder, the other a contracted, infected, irritable bladder—that makes it seem improbable that the two forms of prostatic disease are due to the same causes: inflammatory action seems so pronounced in the latter class, and so latent in the former.

Differential Diagnosis.—Very many of the symptoms and of the physical signs, as well, presented by prostatics, are known to occur in other affections. Hence it frequently becomes necessary for the surgeon to consider the differential diagnosis of these cases, and at times to form his ideas by the method of exclusion.

Atony of the bladder, being itself often caused by prostatic obstruction, may first claim our attention. The symptoms of this malady, even when produced by another cause, may very closely simulate those attendant upon enlargement of the prostate: thus the patient will find himself required to strain immoderately to start the flow of urine, he will be long in emptying his bladder, and may be aware that some portion of his urine constantly remains unevacuated. As a consequence of these changes the frequency of urination may be increased, and it may become impossible to differentiate the two affections from the symptoms alone. But the surgeon will very easily distinguish mere vesical atony from the train of symptoms and their complications due to prostatic enlargement as soon as he seeks a cause for the symptoms. The history of the patients may be the same, but by simply passing a catheter, and palpating the prostate at the same time from the rectum, enlargement of this organ can be readily excluded.

The most common non-obstructive causes of atony of the bladder are diseases of the central nervous system, of which tabes and cerebro-spinal lues are the most important. Lateral and multiple sclerosis are sometimes productive of urinary retention and atony of the bladder. If we assume that all causes of urinary retention give rise secondarily to atony of the bladder walls, a large number of factors must be given etiological influence. Habitual retention continued for many years will cause weakening of the vesical musculature which, with prostatic hypertrophy coming on in later years, becomes much exaggerated. Retention of cerebral or spinal origin may be partial or complete, and not infrequently is followed by incontinence of urine when the sphincteric system becomes partially or completely paralysed. The prostate gland is generally atrophied in the presence of a spinal lesion, but in

some instances a true hypertrophy is found. The symptoms may be characteristic of prostatism even to the overflow of retention, but operation must not be considered until it is definitely proved that the incontinence is not due to the spinal lesion. If in such cases, one can be quite positive that the cord lesion is not far advanced and that the atony of the bladder is due to prostatic obstruction and not to the spinal disease, removal of a large prostatic growth is justifiable.

Atony sometimes results from retention due to hysteria or other psychic causes but this is easily differentiated from obstructive atony. Retention due to reflex, toxic, and infectious causes gives rise to very slight degrees of atony. In a small number of patients the most characteristic symptoms of obstruction at the vesical neck exist, but in which no obstructive cause for the retention and atony can be found. Swinburne attributes the retention in these cases to a reflex from lesions of the rectum or the deep urethra.

The differential diagnosis between atony due to enlargement of the prostate and those cases due to the other causes just enumerated is usually made by cystoscopic examination. In marked states of atony secondary to prostatic hypertrophy the removal of the prostate may be followed by temporary, and usually partial incontinence. In quite a number of cases in which marked over-distention of the bladder exists before operation the removal of the prostate does not completely restore the tone of the vesical musculature, and small amounts of residualurine may be demonstrated to exist in these cases. The functional results however are satisfactory. Atony of the bladder dependent solely upon prostatic enlargement need cause no apprehension if the obstruction is completely removed at operation.

Where **strictures of the urethra** are present, the exclusion of prostatic hypertrophy is more difficult. Although the age of the patient may render the presence of the latter affection extremely improbable, yet many of the symptoms are the same—slow, difficult urination, with atony of the bladder, as well as, possibly, hemorrhoids and prolapsus ani. But the passage of an instrument of full size into the urethra will show obstruction more or less complete to exist within eighteen centimetres of the meatus; and if entrance to the bladder can be gained, the absence of enlargement of the prostate is readily determined by the combined rectal and vesical examination already described. In cases, however, of impermeable strictures with chronic retention, it will not be possible satisfactorily to examine the prostate until these conditions are relieved.

Cystitis, when unaccompanied by stricture or prostatic enlargement, is unattended by residual urine, and although the crebruria may simulate that of overflow from retention, this affection is readily proved not to exist by the passage of a catheter; while combined intravesical and rectal examination will reveal a prostate of normal size.

Quite a number of patients are being subjected to prostatectomy for the relief of urinary incontinence which is in reality caused by tabetic **paralysis of the bladder.** Needless to say the operation not only fails of its purpose but aggravates the condition.

Incontinence of urine due to tabes or other lesions of the cord coexist with true hypertrophy of the prostate gland, and the examiner given to superficiality in diagnosis is very likely falsely to accuse the enlarged prostate and advise its removal. We have seen a number of patients who had previously been operated upon for the cure of an incomplete incontinence which immediately thereafter became complete. The presence of tabes should be suspected in an individual who complains of intermittent incontinence, especially of the nocturnal variety. An important concomitant symptom is loss of sexual power. If on further examination the prostate is found to be only moderately enlarged the certainty of the tabes is enhanced. The bladder wall of tabetics like that of prostatics is frequently trabeculated, but little is gained by cystoscopic examination to aid the diagnosis except to confirm the minor degree of prostatic enlargement. Whenever the suspicion of tabes exists, the patient should be given the benefit of a complete neurological examination. The serological study of the spinal fluid is of paramount importance in the differential diagnosis of doubtful cases.

Where a **vesical calculus** exists, it is not liable to be mistaken for an enlarged prostate unless it is both firmly fixed in the neighborhood of this organ and so thickly coated with mucus that no grating sensation is imparted to the sound. In these rare circumstances it may likewise be missed during the cystoscopic examination. But even under such circumstances there may be no residual urine, which is, as already insisted upon, a nearly invariable accompaniment of every enlarged prostate producing symptoms; and there will probably not be the characteristic change in the curve of the subpubic urethra. If the calculus is prostatic, or even if it merely coexists with an enlarged prostate, a positive diagnosis is more difficult. Stones of considerable size may be readily overlooked during a cystoscopic examination when they have become coated with mucus and lie in a deep post-prostatic pouch. A

diverticulum containing a stone may give rise to much post-operative trouble in cases in which neither the diverticulum nor the stone were diagnosed before operation. In about one out of four patients, it is to be remembered, a calculus complicates the enlarged prostate; according to Freyer, stone complicates prostatic hypertrophy in 17.6 per cent of cases. Bleeding is more common in cases of calculus than in those of enlarged prostate alone, and the pain is less constant, and more confined to times when the bladder contracts upon the concretion, or when the patient is actively moving about. The fact must not be lost sight of that pain due to stone in the bladder which occurs in connection with enlargement of the prostate is felt at the end of micturition, but that in the presence of residual urine, pain may be absent as the bladder walls do not contract in every instance sufficiently to cause contact with the stone. The pain frequently radiates to the end of the penis. In uncomplicated prostatic enlargement pain is usually an insignificant symptom. In calculus, moreover, the greatest frequency of micturition is during the day, and the patients are not apt to be disturbed much at night. A skiagraphic examination will at times detect the presence of a calculus when other means have failed.

Probably the most difficult diagnosis of all is that from **polypoid growths in the bladder,** which when springing from the region of the prostate may very closely simulate a pedunculated "middle lobe" of this organ. But in nearly all forms of vesical tumor, other than prostatic, spontaneous hemorrhage is an early and conspicuous symptom, and is usually not attended by much pain. In some cases, moreover, fragments of the tumor are passed in the urine, so that a microscopic examination may render the true condition of affairs manifest. A polypoid tumor of the bladder which has become encrusted with urinary salts may present a cystoscopic picture very much like that of calculus. The tumor, however, is fixed and careful scrutiny of its basal portion will very likely show that it is adherent to, or rather springing from, the bladder wall. In contour the tumor is usually unlike that of calculus, and some area of the growth will usually have escaped encrustation so that the diagnosis is apparent. There are, however, some cases in which an encrusted tumor so closely resembles in cystoscopic appearance, a calculus that a mistake in diagnosis is excusable.

Tuberculosis of the bladder may occasionally simulate enlargement of the prostate by the symptoms it produces. But it probably

always coexists with similar disease elsewhere in the body, most often in the kidney or epididymis. Hence in doubtful cases this should be borne in mind, and the spermatic cords and seminal vesicles examined as well. The cystoscope here may be of considerable aid, enabling the surgeon to localize a tuberculous ulcer in the bladder, and thus render it accessible for topical treatment. If the tuberculous disease affects the prostate, there can usually be detected areas of softening, in the irregularly enlarged organ; and although it might at times seem difficult to distinguish between areas of softening in a prostate somewhat denser than normal (tuberculous disease), and areas of hardening in a rather less dense organ (adenomatous enlargement with prostatic "tumors"), yet other features in the case will usually enable the diagnosis to be made.

Chronic prostatitis often succeeds upon the **acute form** of the disease, which is sufficiently manifested by its abrupt onset, positive inflammatory character, excessive tenderness on rectal exploration, and by its occurrence, generally as a sequel to gonorrhoea, in a younger patient.

Abscess of the prostate likewise usually follows acute inflammation, but may be traumatic in origin. Besides the history of the case, the course of this affection is so acute compared to that of enlargement of the prostate, that confusion is not likely to arise. Moreover, the abscess may point in the urethra, the rectum, or the perineum; and palpation may enable a diagnosis to be made before rupture renders it certain.

Chronic prostatitis unassociated with periprostatitis rarely gives rise to prostatism: this equally applies to all forms of the disease

By far the greater number of cases of chronic prostatitis are non-obstructive in nature and present no difficulties in differentiation from the adenomatous form of prostatic hypertrophy. In the minority of cases chronic prostatitis is merely a part of a widespread inflammatory process. The inflammation begins primarily in the prostate gland but comes eventually to involve the surrounding structures and results in the deposition of scar tissue. The normal flexibility of the parts is then destroyed and as a result of contracture of the vesical neck the normal bladder function is interfered with and prostatism results.

The prostate gland itself in these cases is usually atrophied, and so dense in consistency that the suspicion of carcinoma is aroused by digital examination of its rectal surface. It is, however, fixed to the pelvic fascia and shows no tendency to spread upward between the vesicles beneath the trigonal area of the bladder, as is characteristic of carcin-

oma. The gland is small and irregular in outline while the carcinomatous gland is rarely atrophied, and, except in later stages, more or less regular in surface outline, with one or more areas of great density. To this type of prostate Chetwood has long since given the name of sclerosis of the neck of the bladder; a name descriptve of the associated pathology in the region of the vesical neck. The less descriptive term atrophy of the prostate is employed by the French to denote the condition.

In a certain small proportion of cases an associated cystitis leads to concentric hypertrophy of the bladder walls. In these cases the bladder capacity is small, and this factor together with the accompanying cystitis, often with ulceration of the mucosa, and the obstruction at the vesical neck, renders this class of patients the most miserable of sufferers. Notwithstanding the small bladder capacity there is usually a small quantity of residual urine present, a quantity small in amount but relatively great for, while the residual may measure only fifteen c.c. the total capacity of the viscus may be only sixty c.c. or even less. The question in these cases is not one of diagnosis alone; more important is the recognition of associated changes such as hydro-ureter, diverticulæ, and stone.

Contracture of the vesical neck associated with the ordinary symptoms of prostatism is diagnosed with ease. Rectal examination proves the absence of large extravesical adenomatous masses, and the true pathology of the disease is easily demonstrable cystoscopically. The conditions commonly found are a bar at the vesical outlet or contracture of the vesical neck caused by an annular deposit of scar tissue.

Malignant disease of the prostate is chiefly of the adeno-carcinomatous variety. In some few instances the tumor cells arrange themselves in irregular nests or in solid strands situated in the midst of a more or less dense matrix. These latter are properly grouped as scirrhous in type. The rapidly growing medullary carcinoma rarely if ever occurs in the prostate gland. One of the chief characteristics of prostatic carcinoma is its tendency to comparatively early and widespread metastases. Practically all organs are subject to these metastatic deposits but the bones are particularly liable. In some instances the osseous system and the pelvic lymph nodes are the only structures involved.

A very small nodule of prostatic carcinoma may, like a similar nodule in the breast, give rise to widely disseminated metastases very early in its course. Among the autopsy records of the Lankenau

Hospital we find the description of such a case. The patient died of shock following a suprapubic prostatectomy. The specimen was found to contain a small peripheral nodule of cancer which had given rise to widespread metastatic deposits in the abdominal and thoracic viscera. A factor of some clinical importance is the tendency of prostatic carcinoma to spread to the medullary cavities of the long bones. The bone marrow is destroyed with the deposition of new bone. The latter is subject to early necrosis. Early and profound anemia and pathological fracture are noteworthy sequelæ of the condition. These, however, are scarcely of great diagnostic importance.

It is of great importance, however, to remember that carcinoma of the prostate is a common disease; far commoner than is usually believed. And not only is it commonly met with clinically, but the frequency with which it is found in operative specimens thought to be benign is remarkably great. In our series there were 7.42 per cent. of these cases, and this proportion would undoubtedly have been greater had the specimen in every instance been subjected to more thorough study. The frequency of cancer of the prostate is said by Young to be in the rate one to five (20 per cent. of 500 cases); by Walker, 16.5 per cent.; by Wilson and McGrath, 15.5 per cent. of 461 cases; by Albarran and Halle, 14 per cent., and by Freyer 13.3 per cent. of 1276 cases.

Autopsy records give even a greater proportion of cancer cases, for among 204 diseased prostates found by Kümmel, 21 per cent. were carcinomatous, while Gebele states that in his experience 38 per cent. of diseased prostates found at autopsy are carcinomatous.

These figures should impress the reader, without further comment from us, of the importance of remembering the frequency of carcinoma when called upon to diagnose the nature of a diseased prostate.

The age-incidence of prostatic carcinoma gives no clue to the nature of the disease since it is practically the same as that of benign hypertrophy. It occurs perhaps on the average a decade later than does benign hypertrophy, but to this rule there are so many exceptions that age is of little diagnostic importance.

In a series of 93 cases reported by Judd, the age-incidence is tabulated as follows:

Number between 50 and 60 years	21
Number between 60 and 70 years	34
Number between 70 and 80 years	36
Number between 80 and 90 years	2
	93

Wolff has reported the histories of six patients under forty years of age; one, twenty-nine years of age.

The symptomatology of early cancer of the prostate is almost identical with that of benign hypertrophy, with which indeed it is often associated. The differential diagnosis between these conditions is either an impossible one to make, or, if made at all is based entirely on the physical signs.

There is however one exception to this, namely, pain independent of micturition which is very suggestive of malignancy. At first localized to the region of the prostate and constant, it later becomes referred especially to the perineum, the back, the buttocks and the thighs.

Referred pain is a late symptom of prostatic carcinoma. It is indicative of involvement of the sheath of the organ in the vicinity of which the large nerve trunks are situated.

The physical findings naturally differ with the state of the progress of the disease, It should not be forgotten that carcinoma may exist in an atrophied prostate, in a prostate of normal size, or in a very marked hypertrophied gland. The size of the organ is not therefore of great importance in the diagnosis. In the absence of associated pathology the carcinomatous prostate is generally moderately enlarged. The contour of the rectal surface of the carcinomatous gland is irregular or nodular in contrast to the regular, or if lobulated, smooth surface of the adenomatous organ. If the surface of a carcinomatous prostate is sometimes smooth it rarely lacks that most characteristic of all physical findings, namely, increased density. In some instances the density of an old fibroid prostate or of one containing a calculus, closely simulates that of prostatic carcinoma and the differentiation between them is extremely difficult.

The small dense prostate, an end-result of an ancient chronic inflammation, is universally involved, and physical examination of one part of the organ is the counter-part of every other portion of the gland. This is rarely true of the carcinomatous organ in which, in one or more parts, the stony induration of the carcinomatous areas will stand out in sharp contrast with the softer non-involved areas. The more advanced cases will scarcely be mistaken for chronic prostatitis. When the malignancy has broken through the sheath and extended upward beneath the trigonum of the bladder, with involvement of one or both vesicles, and possibly an ureter, the diagnosis presents no difficulties.

Areas of stony hardness are then the most important physical findings in carcinoma of the prostate gland. They may occur in one or both lobes and in some instances the carcinoma is confined to a single area in one lobe. The examiner must bear in mind that the big, soft adenomatous prostate which presents itself so obtrusively to the examining finger may contain an area of malignancy. In every case therefore a most painstaking and thorough examination of the entire rectal surface of the gland should be made. Judd reports that 75 per cent. of the carcinoma cases operated upon in the Mayo Clinic are associated with benign hypertrophy.

We will reserve for separate consideration the diagnostic data to be obtained in these cases by the aid of the cystoscope.

Sarcoma of the prostate gland is an exceedingly rare disease. In the few cases that have come to our notice the diagnosis could scarcely have been mistaken since the pelvis was almost filled with a rapidly growing tumor of prostatic origin.

Powers, who has collected a series of thirty-one cases from the literature, states that "the diagnosis is at times easy, at times difficult." To quote this writer further "a rapidly growing tumor of the prostate in a child or youth is probably a sarcoma. So, as well, is a rapidly growing, soft, balloon-like prostatic tumor in an adult. Pain is generally marked, and is referred to the pubes, perineum, and rectum." Of the thirty-one cases, fifteen occurred in children less than eight years of age, eight between the ages of fifteen and twenty-five, and six between the age of fifty and seventy.

Sarcoma is not likely to be mistaken for benign hypertrophy, but if any doubt exists a brief space of time will settle the question, as sarcoma invariably grows with marked rapidity.

Sarcoma of the prostate gland occurs more often in the young than in the aged and rarely gives rise to symptoms of urinary obstruction until late in its course. As an indication of its rarity may be mentioned the fact that Proust and Vion were able to collect only thirty-four cases in 1907. To these Young adds a case and upon this series of thirty-five cases bases the statistics for an excellent chapter which he has contributed on the subject in Cabot's Modern Urology, Vol. I. Of these thirty-five cases only eight occurred between the ages of fifty and eighty years.

The differentiation between benign prostatic hypertrophy and sarcoma of the prostate is not often difficult. The sarcomatous prostate grows with a rapidity that is unknown in the benign disease, notwith-

standing which it gives rise to the symptoms of prostatism, either late in its course, or not at all.

By the time the patient is prompted to seek advice because of dysuria the tumor will have reached a considerable size, sometimes almost filling the pelvis.

The tumor is usually oval in form, smooth in outline and soft, almost fluctuating in consistency. It may however be lobulated and irregularly indurated.

Sarcoma usually springs from the upper part of the prostate and shows little or no tendency to invade the bladder, after the manner of a benign enlargement. It pushes the bladder upward and forward and in this way impairs its function. But this is late in occurrence. Invasion of the urethra takes place in some cases. Metastases occur early and the tumor spreads rapidly and widely among the pelvic contents.

The tumor grows more slowly in the aged than in the young. It is likely to be mistaken for benign hypertrophy, carcinoma, or abscess, depending upon the physical characteristics of the mass. A large soft, almost fluctuant mass suggests abscess to the examining finger, but the systemic symptoms are wanting and the sarcomatous mass is rarely very tender.

The smaller and irregularly indurated sarcoma of the prostate somewhat resembles benign hypertrophy but with this important distinguishing difference, that the sarcoma grows with greater rapidity, and since it usually springs from the upper portion of the prostate is situated at a higher level and obliterates the normal line of demarcation between the upper edge of the gland and the bladder, which is almost without exception demonstrable in cases of benign hypertrophy.

Pain is commonly associated with prostatic sarcomata.

Carcinoma will not be confounded with sarcoma if one remembers that the development of carcinoma proceeds slowly with upward extension along the intervesicular area and the production of a broad flat placque of irregularly indurated tissue.

The marked induration so characteristic of carcinoma is wanting in sarcoma. Hematuria, a late symptom in carcinoma, is rarely associated with sarcoma.

The cystoscope will be of value in the diagnosis of sarcoma only in demonstrating the presence of an extravesical mass with elevation and distortion of the trigonal area of the bladder.

The Cystoscopic Diagnosis of Prostatic Hypertrophy.—The diagnosis of prostatic hypertrophy cannot be said to be complete

without a cystoscopic examination. True, the presence of a large hypertrophied prostate may be determined by rectal examination, and much may be learned by instrumental exploration of the urethra and the bladder. But a thorough study of the intravesical portion of the enlarged prostate, and of the vesical complications that are associated with it, must be made cystoscopically.

Cystoscopy in the aged is, however, not without danger and it is not a procedure that should be used routinely. Almost every patient with an enlarged prostate can be cystoscoped safely at some time during the course of his pre-operative treatment. Before the examination is attempted, the general health of the patient must be such that he will react promptly to the not inconsiderable trauma attendant upon it. So far as the urological contra-indications are concerned, marked renal insufficiency is by far the most important. An examination undertaken under these circumstances may precipitate an impending uremia which not infrequently proves fatal. If patients belonging to this group are given the necessary preliminary treatment, the renal function will be restored little by little and the time will arrive when cystoscopy and later prostatectomy can be done with comparative safety.

Cystoscopy is especially dangerous in that group of cases in which the amount of residual urine is great, the kidney function markedly impaired, and in which the bladder has never been instrumented. Patients who have led catheter lives for a considerable period of time and whose kidneys have been thus decompressed, as indicated by a good functional capacity, may be cystoscoped with safety. Patients in the early stages of prostatic hypertrophy with small amounts of residual urine and good kidney function may be cystoscoped at once. No patient with the history of a recent attack of acute urinary retention should be cystoscoped until the state of his renal function is determined.

Profuse hematuria is a contra-indication to immediate cystoscopy. With proper treatment, the bleeding, especially if it comes from prostatic varices, will subside, whereupon the examination can be made more safely and more satisfactorily. The same rule applies to cases complicated by severe acute cystitis.

Patients who show a tendency to urethral fever after the passage of a catheter should not be cystoscoped; it is safe in these cases, if the diagnosis of prostatic hypertrophy is clinically justifiable, to proceed at once with a preliminary cystostomy.

If it is found that the introduction of the instrument is attended with unusual difficulties the operator must not persist in his efforts. Such difficulties arise from stricture of the urethra, both organic and spasmodic in type; from marked distortion of the prostatic urethra caused by bizarre forms of the invading prostatic tumor; from unusually large tumors with great intravesical projections, and from unusual sensitiveness of the urethra and the vesical neck. Nothing can be gained from a cystoscopic examination that would warrant the infliction of long and great suffering on an old man with an enlarged prostate. In the hands of a skilful cystoscopist, and no cystoscopist is skilful who lacks gentleness in his methods, the great majority of prostatics can be examined safely but the time for such examination should be selected by the individual who is directing the course of pre-operative treatment.

Technique.—The details in the technique of cystoscopy will be omitted except in so far as they pertain to the examination of prostatic cases. We prefer for these studies a simple examining instrument with an irrigating attachment; one that permits of water distention of the posterior urethra which can thus be examined together with the bladder, and a good picture obtained of the vesical outlet. Ureteral catheterization is rarely necessary in prostatic cases, and with the elimination of the catheter channels a smaller instrument can be employed without sacrificing the dimensions of the field. Some prefer an indirect instrument after the original Nitze pattern in which the image is inverted, and claim to get a better view especially of the posterior margin of the vesical outlet with this instrument. Others employ a direct cysto-urethroscope for the examination of the proximal urethra. Personally we prefer to use a corrected image *indirect cystoscope* and have found the greatest satisfaction with the cysto-urethroscopes of American manufacture.

Having determined the fitness of the patient for cystoscopic examination he is given a hypodermic injection of morphine. One-half hour later he is placed on a suitable cystoscopic table, or, in the absence of this, on a flat examining table with the legs hanging over the edge of the table and the feet resting on chairs; in the absence of appropriate leg rests we do not use the ordinary lithotomy stirrups, but prefer the position described above.

After the necessary preparation, which includes irrigation of the anterior urethra with warm boric solution, a small tablet of apothesine or procain is placed within the lips of the meatus. After the lapse of a

few minutes the remaining portions of the urethra are anesthetized. For this purpose we employ a two per cent. solution of procain. The solution may be introduced into the urethra through a small French catheter or other suitable instrument. We usually employ a metal syringe the barrel of which has a capacity of 30 cc.; the cannula, which has a screw attachment to the barrel, should have a calibre of at least 22°F. This is simply a Keyes-Ultzmann syringe of large size.

The cannula is introduced into the urethra as far as the bulbous portion at which point a small quantity of the anesthetic solution is ejected from the syringe. This serves to remove the tendency to spasm on the part of the compressor urethra and the external vesical sphincter muscles. After waiting a few minutes the tip of the cannula is introduced into the prostatic urethra into which the remaining portion of the anesthetic is introduced. The instrument is then withdrawn and after a few minutes the cystoscope may be easily, and usually, painlessly introduced. If the patient has recently emptied the bladder the amount of residual urine may now be determined, although this will probably have been estimated previously. The next step in the procedure is to obtain a clear medium through which the interior of the bladder may be examined. This often necessitates repeated washings to remove pus and blood. If the bleeding is excessive, adrenalin chloride is added to the irrigating fluid and only small quantities of the latter are introduced into the viscus at each washing since the bleeding will be encouraged by over-distention. Normal saline solution, boric acid solution or a one to ten thousand solution of oxycyanid of mercury is used for irrigating purposes. These solutions should be tepid but never very warm.

Having obtained the maximum of cleanliness of the bladder mucosa, and a corresponding clarity of the distending medium, about 200 to 250 cc. of the latter are introduced and the examination is proceeded with. In most cases the cystoscopic examination may be easily and systematically completed; in cases with small contracted and highly intolerant bladders the examination may be exceedingly difficult and the results attained most unsatisfactory.

Cystoscopy in prostatics as well as in other bladder cases is an operation that should be conducted systematically. The instrument is first turned so that the summit of the viscus is within range of vision, whereupon it is introduced into the bladder as far as possible without doing injury to the wall against which the beak presses. In the large capacious atonic bladders some difficulty may be experienced in ob-

taining sufficient distention to efface the redundant folds of mucosa, or having accomplished this, to bring the remote portions of the bladder wall within the range of cystoscopic vision. The window of the instrument is brought near to the mucous membrane by depressing the ocular end and the interior of the highest portion of the bladder is then carefully examined as the instrument is slowly withdrawn. When the window approaches the urethra a curtain-like structure will be seen which obscures the upper part of the field, and below and behind this the bladder cavity appears as a shadowed space. This curtain is the sphincteric margin, and represents the dividing line between the bladder and the prostatic urethra. The instrument is again pushed into the bladder cavity as far as possible and another portion of the mucosa is examined adjacent to that at the summit of the viscus. This procedure is repeated until all of the interior of the bladder is examined except its basal portion, or in other words, until the summit and the lateral walls have been examined. Compared with the face of the clock this portion is represented by the part between eight o'clock and four o'clock.

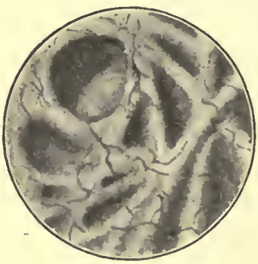

Fig. 56.—Trabeculation and Diverticula of Bladder Wall. (*Knorr.*)

The next step in the examination is the observation of the sphincteric margin. Under normal circumstances this is a rounded regularly concave structure in its upper and lateral portions, but lacks sharp definition below since it becomes here a part of the trigonum. The normal internal vesical sphincter, as viewed cystoscopically, resembles a horseshoe in outline. Distortions of the outline of this concave curtain are among the most important cystoscopic findings in enlargement of the prostate. In order to produce these irregularities the enlarged prostate must encroach upon the sphincteric area; there must be an intravesical projection of the enlarged organ. In some cases, and especially in early ones, the growth of the adenomatous bodies is for the most part into the urethra under which circumstances the sphincteric outline will be normal.

Before attempting to interpret the many cystoscopic pictures presented at the vesical outlet of prostatics, one must first understand the anatomy of the normal outlet and familiarize himself with the gross pathology of the enlarged prostate. He will then have no difficulty in

visualizing the various intravesical forms, or in recognizing them when they are met with cystoscopically.

In many instances the intravesical portion of the enlarged prostate is excessive in size and the vesical outlet is so far displaced upward and inward that it becomes a difficult matter to outline the orifice. In the majority of instances, however, the characteristic alteration in the sphincteric margin can be demonstrated. These are of two principal types namely—bulgings and clefts. If in any segment of the ring the normal concavity is replaced by a convexity which is covered by approximately normal mucous membrane, we know that some abnormal

FIG. 57.—BASE OF THE PROSTATE AS SHOWN BY CYSTOPHOTOGRAPHY.—(*Ramon Guiteras A Text-book of Urology, D. Appleton and Co.*)

growth or mass is invading the bladder from outside and below the sphincter muscle. Again, if in one or more segments of the sphincteric ring, bulgings or prominences are found which come together and thus produce clefts, it is evident that we have to deal with separate masses which are encroaching side by side on the sphincteric area. If the upper and lateral portions of the vesical outlet are normal with clefts at eight o'clock and four o'clock, and if it is necessary to depress the ocular end of the instrument to see the summit of a mass situated in the mid-line of the floor of the sphincteric area, it is evident that we are dealing with a median lobe enlargement.

Having examined the region of the vesical outlet, attention should be directed to the trigonal, ureteric, and post-trigonal areas. This part of the examination is of the greatest importance, not only in the determination of the presence of prostatic hypertrophy, but in the dis-

covery of complications which usually affect this portion of the bladder. It is here that calculi usually lodge; here also are found diverticula and saccules, and complicating tumors of the bladder wall are especially prone to occur in the region of the ureteral orifices. In cases suspected of renal complications the ureteral orifices must be brought into view, and this further increases the importance of this area.

Of great importance in the diagnosis of prostatic hypertrophy is the relation which the ureteral orifices bear to the sphincteric margin. In normal circumstances the vesical outlet represents one of the apices of an equilateral triangle the sides of which are approximately two and a half cm., the other apices being represented by the ureteral orifices. With an intravesical enlargement of the prostate, especially in the basal area, this triangle, which is the trigonum vesicæ, is foreshortened and the ureteral orifices are frequently out of sight, being situated behind the projecting edge of the invading mass.

By introducing the instrument further into the bladder and elevating the ocular end, a median lobe may be compressed by the shaft of the instrument so that oftentimes the ureters can thus be brought into view. The difficulties of bringing the ureters into view and the estimation of the shortening of the trigonum is a valuable index of the degree of intravesical enlargement of the prostate. Large calculi may occupy the post-prostatic pouch and escape notice unless a careful examination is made of the basal area. We are also thorough in our search for diverticula, for while we have not met with them as serious post-operative complications in many instances, yet the presence of a large diverticulum may negate entirely the expected benefit to be derived from removal of an enlarged prostate.

The patient with a large diverticulum should be told that a second operation will be necessary to relieve him completely of symptoms of prostatism. The residual urine and all of its serious consequences will continue even after the removal of the enlarged prostate.

Having completed the examination of the bladder and the vesical outlet we next pay special attention to the meati of the ureters. Here we may find gross evidence of disease, such as a plug of pus projecting from the ureteral meatus, or one or other ureteral meatus may have lost its sphincteric control and stand gaping, wide open. Streams of cloudy or bloody fluid may be seen coming in spurts from one or both ureters.

In the event of suspected kidney disease the examination will have been begun with a double catheterizing cystoscope. The ureteral catheters will now be introduced into the ureters, if there is good

reason to believe that one or other of the kidneys is surgically diseased. Specimens of urine are collected from each kidney.

An intravenous injection of indigo-carmine (10 cc. of .04 per cent. solution) is now given and the appearance time of the drug noted. Specimens of urine are again collected in order to determine the relative intensity of the dye secreted by the two kidneys.

In many cases it is impossible, or inadvisable, to pass catheters into the ureters, and under these circumstances if kidney disease is suspected the indigo-carmine is injected and its appearance-time merely noted. We will have already determined in these cases the total functional capacity of the kidneys as measured by the output of phenolsulphonephthalein; the sole purpose of the cystoscopic investigation in this connection is to determine the presence or absence of gross lesions of the kidney that would under ordinary circumstances demand surgical treatment. This can be determined quickly and safely by chromo-ureteroscopy. We do not employ the differential phthalein test in these cases. If the total phthalein output is normal or approximately so, and if indigo-carmine is eliminated from each kidney within the normal time limit there is no justification for further investigation of the state of the kidneys in a patient who is in obvious need of prostatectomy.

It is desirable to conduct the cystoscopic examination in an orderly and thorough manner, and to promote thoroughness, it is advisable to cultivate the habit of recording immediately any abnormalities that may be met with. As a means of recording the various fields examined when outlining the vesical outlet, the graphic method described by Young is admirable. The examiner provides himself with a chart consisting of a series of small circles arranged around a common focal point. Each circle represents a cystoscopic field and into it is drawn an outline of the margin of the bladder outlet as it appears in the particular portion under examination. With the corrected image cystoscope, the parts are seen in their true relationship although magnified more or less in respect to the proximity or distance with which the lens of the instrument is placed in relation with the object. We prefer to begin the examination at the superior or anterior margin of the outlet where, under normal circumstances, the sphincteric margin appears as a shallow concavity. In the presence of lateral lobe hypertrophy with intravesical growth this concavity will be replaced by a cleft to either side of which bulgings will be observed. If the enlargement of the gland is symmetrical, the cleft will be placed in the midline. When

one lateral lobe invades the bladder to a greater extent than its fellow, the urethra will be displaced accordingly, and the cystoscopic picture shows the cleft displaced to the side opposite that of the lobe which is the more involved. It is important to remember that in the presence of intravesical projections of the prostate one observes during a cystoscopic examination, not the sphincteric margin, but the edge of the intravesical growth; the sphincter muscle has been pushed aside by the invading tumor and, as a rule, lies far removed from the bladder outlet.

Fig. 58.—(Above) Edema Bullosum, in Connection with (below) Bilateral Hypertrophied Prostate.—(*Lewis and Mark.*)

Having observed and recorded the alterations at the superior margin of the bladder outlet, the instrument is rotated and "field by field" the entire outlet is examined. With the examination completed, the cystoscopist will have a rather exact idea of the type and extent of the intravesical growth. By joining the arcs of the different circles which he has drawn on the chart, a permanent record of what he has observed is provided.

The inexperienced cystoscopist will perhaps be misled by clefts which are sometimes found at the superior portion of the outlet and which are due to contractions of the sphincter muscle. In congested states of the prostate which so often accompany vesical calculus, a cleft may be observed in this same locality. It is important also to remember that the pressure of the shaft or break of the instrument

will efface clefts or bulgings, so that in examining any given segment of the outlet the lens should be held as far from the object as possible.

Differential Cystoscopic Diagnosis.—The cystoscope is of the greatest value as an aid in the differentiation of prostatic hypertrophy from vesical calculus, bladder tumors, diverticula and other conditions which may give rise to the symptoms characteristic of prostatism. When, by its aid we have determined the absence of intravesical enlargement of the prostate in a patient who presents the symptomatic picture of benign prostate hypertrophy, we have learned much of diagnostic importance by exclusion. In the absence of an intravesical cause for the patient's suffering a mechanical factor will probably be found at the beginning of the urethra. This is frequently a median bar formation or a sclerosis of the vesical neck, which may be either malignant or inflammatory in origin. Enlargement of the subcervical group of glands is likewise a cause of median bar formation, which must be differentiated from true prostatic enlargement. Chronic prostatitis is of importance in this connection only in so far as it gives rise to bar formation or sclerotic changes in the region of the vesical neck.

In rare instances well-circumscribed hypertrophic nodules may invade the urethra early in the course of prostatic hypertrophy and give rise to obstructive symptoms long before marked general hypertrophy of the prostate is demonstrable. This is particularly true of median lobe hypertrophies.

The presence of these conditions may be determined instrumentally. Both the aero-urethroscope and the cysto-urethroscope are used in the study of the deep urethra and the vesical outlet.

Carcinoma of the prostate gives rise to the early production of a median bar but the nature of this cannot be determined cystoscopically in the absence of ulceration or other more characteristic findings.

The rectal examination furnishes more important diagnostic data than does the cystoscope in carcinoma of the prostate. In advanced cases when the carcinoma has caused an elevation of the trigonum vesicæ and ulceration, and has otherwise produced a characteristic cystoscopic picture, the condition will certainly be recognizable by rectal examination. In cases where benign hypertrophy and carcinoma of the prostate co-exist and in which bleeding is a prominent symptom the cystoscope is of the greatest value in determining the operability of the case.

Some few cases are met with in which a diagnosis of carcinoma of the prostate cannot be made by rectal examination alone, while the

cystoscopic data is conclusive. These are the rare cases in which the malignancy takes origin from portions of the prostate adjacent to the urethra.

Sclerosis of the proximal urethra and the vesical outlet commonly occurs in prostatic carcinoma of the scirrhous variety. It is difficult in the absence of ulceration or of characteristic induration of the gland to distinguish these cases from ancient prostatitis or peri-prostatitis. Indeed, the products of inflammation may so closely mimic malignant induration as to render the diagnosis almost impossible. In the inflammatory cases there is more likely to be an apparent shortening of the prostatic urethra with a sharp edged median bar at the posterior lip of the vesical outlet. Just in front of this bar will be observed a cavity the lower limit of which is represented by the posterior declivity of the verumontanum. This cavity is caused by an increase in the antero-posterior diameter of the urethra, and the presence of the median bar toward which the verumontanum is drawn by contractions of the inflammatory tissues. In malignant cases the peri-urethral sclerosis takes the form of a non-resilient annular induration which is more resistant to dilatation than is inflammatory sclerosis.

In the absence of obstructive causes for the presence of residual urine and concomitant symptoms of prostatism, our attention is directed to the nervous system as the cause of the vesical atony. The cystoscope in these cases may reveal trabeculation of the bladder wall, which in the absence of mechanical obstruction or infection is suggestive of spinal cord disease.

To recapitulate, the cystoscope is of the greatest value in determining the presence or absence of obstructive lesions at the vesical outlet, the type of such obstruction and the type of operation indicated for its removal, and, finally in the absence of an obstructive cause of prostatic origin, in determining the nature of the disease giving rise to the symptoms of prostatism.

KIDNEY FUNCTIONAL TESTS

Kidney functional tests have so multiplied that a detailed description of all of them would be impracticable. We will discuss here only those tests that are employed in our daily work and in the results of which we have learned to place considerable confidence. Furthermore, the tests will be discussed only from the standpoint of their application to prostatic cases.

It has been our experience that no one of the functional tests is

infallible and that judgments based on the findings with a single test are very likely to be misleading. There is, however, no justification for condemning as useless, all of the tests because in certain instances one test fails to reveal the true functional capacity of the kidneys.

In our prostatic work the percentage elimination of phenolsulphonphthalein and the degree of urea retention in the blood are the most important criteria of kidney function. The normal kidneys may fail in the excretion of a normal amount of phthalein, but there will be no abnormal retention of urea in the blood of an individual whose kidneys are functioning normally. If a poor output of phthalein occurs in a prostatic whose blood urea remains normal with a diet containing ordinary amounts of proteids, we attribute very little significance to the low output of the dye.

Diminished phthalein excretion and urea retention usually occur together, but this is by no means the invariable rule. To condemn functional tests because of these exceptions is a mistake. With proper interpretation the results of blood urea estimation and phthalein elimination insures, insofar as the state of the kidneys is concerned, the proper selection not only of patients suitable for prostatectomy, but of the time best suited for the operation.

Indigocarmin was first used by Heidenhain in 1874 in the experimental study of renal physiology. The fact was established in these experiments that the drug is eliminated by the epithelial cells lining the convoluted tubules. The test was not applied clinically however until 1903, when Voelcker and Joseph introduced it into practical medicine.

In the meantime the advantages and disadvantages of methylene blue as a means of testing kidney function had been carefully determined by Achard and Castaigne. Indigocarmin was soon found to be somewhat superior to methylene blue but to possess also some of its inherent disadvantages. Thus, while it was found that the appearance-time of indigocarmin was less than that of methylene blue, the same difficulties of quantitative estimations were encountered in both tests.

These difficulties exist for the very good reason that only indefinite amounts of the drugs (not more than 25 per cent. of indigocarmin) are eliminated by the kidneys, the fate of the remaining portions in the body being unknown.

Indigocarmin is much to be preferred however, because of its prompt appearance in the urine in maximum intensity within a comparatively short period of time. The elimination continues for a period of from

twelve to twenty-four hours, while methylene blue may be found in the urine for periods ranging from twenty-four hours to several days in normal individuals.

Collection of the entire amount of either drug eliminated by the kidneys is not essential for qualitative estimations of kidney function, but these tests, for reasons already given, do not lend themselves to accurate quantitative readings. It is possible however to make fairly accurate estimations of the percentage elimination of the dyes by matching the color of the collected specimens of urine with solutions containing known quantities of the drugs. In this manner a fairly accurate estimation of the amounts of the drug eliminated during a given period of time can be made. Various methods and forms of apparatus have been suggested for the purpose of employing the indigocarmin test quantitatively, but since the introduction of the phthalein test these have been abandoned in the majority of clinics.

The indigocarmin test has a very definite field of usefulness, however, and we would not limit its application, as do some writers, to that of locating the ureteral orifices in difficult cases. In fact, it has been our experience that in differential studies of kidney function the indigocarmin test is in certain instances equally as important as the phthalein test; we should be very loathe indeed to part with either one. The controversy that has arisen in certain quarters regarding the relative merits of these valuable diagnostic aids could well be settled by a proper appreciation of the great value of each test.

We advocate and employ the indigocarmin test in all cases where differential studies of kidney function is necessary, and in which ureteral catheterization with the prolonged instrumentation necessary to complete a differential phthalein test is unjustifiable; this includes the great majority of prostatics.

In cases of prostatic hypertrophy in which a complicating kidney infection is suspected, the following method of procedure may be carried out:—

The bladder cavity is cleansed by repeated washings with warm boric acid solution. A double catheterizing cystoscope is then introduced. After making a careful survey of the interior of the bladder, paying special attention to the region of the bladder outlet, an intravenous injection of 10 cc. of a 0.4 per cent. solution of indigocarmin is given. The meati of the ureters are then located and the appearance of the drug watched for. In individuals with normal kidneys a spurt of urine stained an intense blue will be observed coming from each ureter

in from three to six minutes after the indigocarmin solution has been injected. In certain instances the appearance-time is prolonged under normal circumstances to ten minutes. Needless to say the solution of indigocarmin must be sterile and free from insoluble particles.

If there is a prolongation of the appearance-time, or if there is in addition to retardation in elimination, a marked difference in the intensity of the blue from one or the other side, a ureteral catheter may be passed into the ureter and a sample of urine from the obviously diseased side collected.

The experienced cystoscopist will learn a great deal regarding kidney function, not only from the delay in the appearance-time of the drug in diseased states of the kidneys, but also from the relative differences in the intensity of the blue from the two kidneys.

This test obviously lacks the refinements of the phthalein test in differential studies of kidney function, but insofar as the prostatic is concerned, we have learned to place great reliance on it in the study of complicating surgical lesions of the kidneys.

If after the intravenous injection of indigocarmin, the drug fails to appear in the urine from one kidney within a period of fifteen minutes and then only in a faint spurt, while the kidney of the opposite side excretes the drug promptly and in full intensity of color, there is in all probability a surgical lesion of one kidney present. In the event of the prostatic obstruction not demanding immediate attention, it is advisable to enlist the aid of the ureteral catheter, the differential phthalein test, and possibly pyelography, to aid in the diagnosis. If, however, the total phthalein output is satisfactory and the blood urea content is relatively normal, the kidney complication may be disregarded; if the prostatic condition urgently demands relief the bladder should be drained suprapubically at once.

The further course of treatment should be guided by the total percentage output of phthalein, the urea content of the blood, and the patient's general condition. These being found satisfactory, the prostate should be removed even though the patient has a diseased kidney that would necessitate either removal or drainage under ordinary circumstances.

The important consideration in the average case of prostatic hypertrophy coming to operation is not the exact state of the kidney tissues pathologically, but whether there is enough normal renal tissue remaining that will, when functioning at its maximum capacity, be able to support life, although subjected to the shock, hemorrhage, and toxemia

incident to anesthesia and operation. This can best be determined by comparing the total phthalein output and percentage content of kidney retention products in the blood before and after preliminary treatment designed to decompress the kidneys.

Phenolsulphonephthalein is one of a class of chemical compounds first produced by Remsen through the action of orthosulphonbenzoic acids upon the phenols. It consists of a bright red crystalline powder which is soluble to some degree in water but more so in alcoholic solutions, and is freely soluble in alkaline solutions.

The first indication of its clinical possibilities came with the demonstration by Abel and Rowntree that the drug is non-toxic and non-irritant when injected into the tissues. These observers further noted that it was quickly excreted from the body, almost entirely in the urine and that complete elimination of small quantities took place within a comparatively short period of time. By the addition of alkalies to the urine the brilliant red color of the drug is restored, so that the possibilities of the drug as an accurate, quantitative colorimetric test of kidney function were soon realized. The elimination of this particular phthalein by the kidneys differed from that of all other phthaleins, and the clinical possibilities of the drug which the original investigators noted have since been fully demonstrated.

One of the remarkable features of the drug is that it is almost completely eliminated by the kidneys. After subcutaneous injection it appears, as Abel and Rowntree first showed, in the bile, but is subsequently re-absorbed by the intestinal lymphatics, so that even with the administration of large doses only traces of phthalein are to be found in the feces.

After a series of animal experiments the original investigators came to the conclusion that the drug is "entirely devoid of toxicity, probably more so than sodium chloride."

The interest of the clinician was then enlisted, and Geraghty, assisted by Rowntree, began a study of its clinical application. The results of these studies were presented to the American Association of Genito-Urinary Surgeons in 1910. The technic then described has undergone but little change and the conclusions then arrived at have needed but little, if any, revision.

In order to establish a standard in their clinical study the authors first tested a series of cases in which the kidneys were thought to be normal. A dose of 6 mg. was selected and with this amount the appearance-time of the drug in the urine, when injected intramuscularly,

was from 5 to 11 minutes, and the amount excreted varied from 40 to 60 per cent. during the first hour, and from 20 to 25 per cent. in the second hour. The total normal excretion in the two hours varied from 60 to 85 per cent. They found also that the percentage output of the normal kidneys is constant irrespective of the amount of urine, and that when large doses of the drug are injected, the percentage output is relatively lower but the absolute amount is greater.

The clinical part of the paper by Geraghty and Rowntree was a resumé of the results of the phthalein test in fifty-three cases of prostatic hypertrophy. The results of these studies established the phthalein test as pre-eminent among functional kidney tests in cases of enlargement of the prostate. Subsequently the technic was developed to include the estimation of function of the individual kidney. In our prostatic work the differential phthalein test is rarely used, but we depend largely upon the results of this test for the estimation of total renal function in this, as well as in other surgical diseases.

Technique of the Phthalein Test in Prostatic Hypertrophy.—One-half hour before injecting the drug the patient is instructed to drink several glasses of water. This will stimulate free urinary secretion, thus insuring a prompt appearance of the phthalein in the urine, or rather removing the possibility of delayed appearance-time because of a lack of secretion.

The bladder is then emptied per catheter and the instrument is allowed to remain in situ. One cc. of a sterile solution containing 6 mg. of the drug is injected intramuscularly, preferably into the lumbar muscles. Exactness in dosage is of vital importance since even the slightest variation will destroy the accuracy of the test. We use an accurately graduated tuberculin syringe for injecting the drug. Hospital attendants must be carefully instructed in making the injection if mistakes are to be avoided; they must be impressed with the necessity of injecting into the substance of the muscle, not into the skin or the subcutaneous tissues, exactly one cc. of the solution.

Having noted the time when the injection was made, the urine which flows from the catheter is collected in a test tube containing a small quantity of 25 per cent. sodium hydroxide solution. The initial appearance of the drug in the urine is denoted by a pink color in the alkaline solution which quickly changes to a brilliant red. The appearance-time of the drug is then recorded. The catheter is now corked and the urine is allowed to accumulate in the bladder for a period of one hour, when it is drained into a suitable receptacle which is then set aside

while the collection of the second hour specimen is being made. The two containers are then sent to the laboratory for a colorimetric determination of the percentage amounts of phthalein.

In estimating the kidney function in patients who have no residual urine it is unnecessary to employ a catheter except in cases where accuracy in determining the appearance-time of the phthalein is desired. These patients are instructed to void at the end of one hour and ten minutes and two hours and ten minutes after the injection of the drug, ten minutes being added for the delay in excretion.

The estimation of the percentage of excretion of the drug is a matter of commendable simplicity. To the specimens is added sufficient sodium hydroxide to make the urine strongly alkaline. If the urine contains large quantities of ropy muco-pus and blood it should be filtered and well diluted before the alkali is added, otherwise the readings will not only be difficult but in accurate. An acid urine containing phthalein is yellowish brown in color; this changes to a brilliant Bordeaux red when alkalies are added.

After thorough alkalinization the specimens are placed in graduates or flasks of 1000 cc. capacity and distilled water is added to make 500 cc. If the resulting solution has a fairly deep red color the dilution is increased to 1000 cc. In estimating small percentages of phthalein it is much easier and more accurate to employ lower dilutions and divide the results rather than to attempt to estimate the percentage amount of the drug in very faintly colored solutions.

The estimations, which may be made with any one of the standard colorimeters, should not be deferred, especially if the solution has been alkalinized, since the red color gradually fades if the solution is allowed to stand.

In doing differential functional studies of the kidneys the intravenous method of administering phthalein is preferable, since the rate of elimination is much more rapid. As mentioned above, we rarely employ phthalein in differential kidney studies of prostatics. We prefer to rely upon the less accurate, though, in our judgment, more practical indigocarmin test in these aged individuals in whom long-continued instrumentation is inadvisable. We advise the reader who desires a detailed discussion of the phthalein test in all of its phases to consult the writings of J. T. Geraghty; there he will find described in the thoroughness characteristic of the scientific work of this writer the various methods of using the test, and an interpretation of the results obtained both in health and in disease.

In normal individuals an average of 50 per cent. of phthalein is eliminated during the first hour, and after intramuscular injection most of it is eliminated during the first two-hour period. As Geraghty has shown, the moderately diseased kidney will continue to excrete a fair amount during the third and fourth hours. Slight changes in function can, he says, be most accurately demonstrated by one hour's collection following an intramuscular (lumbar) injection. We are fond of comparing the rates of elimination during the first and third hours. A relatively late high percentage output indicates secretory inactivity of the renal epithelium if not actual disease.

The Phthalein Test in Cases of Prostatic Hypertrophy.—The kidneys of practically all prostatics are functionally below par. This is usually due to mechanical interference with renal function incident to urinary obstruction, but is often contributed to by antecedent nephritis or infections complicating the enlargement of the prostate.

Actual destruction of the renal parenchyma may occur through the action of bacteria or it may merely represent pressure atrophy secondary to lower urinary obstruction. More often actual destruction of renal tissue has not occurred, and the diminished function may be improved by treatment. The purpose of the functional tests is to determine the presence of these changes and to estimate as accurately as possible the reserve capacity of the kidneys.

We do not like to discard as useless those tests upon which so much dependence was placed in the past. We continue to note most carefully the specific gravity and total quantity of the urine and the output of urea and total solids. A persistently low specific gravity of the urine in a case of prostatic hypertrophy makes us quite as apprehensive as to the outcome of operation as does a low percentage output of phthalein.

A low output of phthalein, while indicative of renal derangement, may be temporary. We have operated upon a considerable number of patients in whom prostatectomy had been refused by other surgeons because of a low output of phthalein, and have had good results notwithstanding.

In answer to a questionnaire relative to the value of kidney functional tests which was sent to numerous operators, one correspondent tells us that several of his patients who were refused operation because of a low phthalein output were successfully operated upon elsewhere. In this experience he finds reason for utter condemnation of the test. He unfortunately interpreted the low output of phthalein in these

cases as evidence of irremediable kidney destruction, whereas in fact it probably indicated a temporary abeyance in kidney function due to removable causes.

A prolongation in the appearance-time of phthalein and a decrease in the percentage output of the drug in prostatics are danger signals, but they do not necessarily indicate the inoperability of any given case. It is necessary in these cases to employ preliminary treatment and to continue it until a relatively normal function of the kidneys is re-established before prostatectomy is undertaken. This includes decompression of the kidneys either by means of the catheter or by cystostomy, together with the administration of large quantities of water by mouth and by rectum, or in rare instances by subcutaneous injection. Diuretics and urinary antiseptics are sometimes indicated and may be of some benefit. Suprapubic cystostomy under local anesthesia is, we believe, less dangerous than difficult urethral instrumentation.

Cases are occasionally reported, such as the one mentioned by Keyes, in which there was total failure in phthalein elimination, yet the patient was successfully operated upon, not once but several times, and never showed any evidences of the loss of kidney function other than the failure to eliminate phthalein. Unless the initial test shows an extremely low output of phthalein we are not especially concerned with its prognostic significance. However, if the percentage output of the drug does not increase or continues to diminish under preliminary treatment, we feel the greatest concern over the situation. The question arises under these circumstances whether an attempt to enucleate the prostate is justifiable. If the ideals in preliminary treatment have been fulfilled and if in spite of this there is blood retention of urea in proportion to the diminished excretory powers of the kidneys as measured by phthalein, we advise against prostatectomy. In certain cases cystostomy is necessary and the patient must be provided with a permanent suprapubic drain and urinal attachment.

In the opinion of Geraghty diminished kidney function in prostatics due to infection has a much graver significance than lowered function dependent upon interstitial nephritis. With this we agree as far as the dangers of immediate operation are concerned, but we would prefer a case of the infectious type with the hope of ultimate successful prostatectomy to one with a dangerously low kidney function resulting from interstitial nephritis. In the former, we may expect response to judicious preliminary treatment, in the latter the kidney destruction is irreparable.

To state in terms of percentage output of phthalein when prostatectomy can be safely undertaken is impossible. It is only through the employment of this and other tests in conjunction with suitable preliminary treatment that the functional reserve capacity of the kidneys can be measured.

The phthalein test is unquestionably of value but the kidney is only one of several organs upon the proper functioning of which the success of prostatectomy depends. The operation should not be undertaken until the cardiac, digestive, metabolic, vasomotor, and other functions are known to be relatively normal.

We have already remarked upon the impossibility of determining accurately in every instance by means of the phthalein test, the ability of the kidneys to weather the strains incident to prostatectomy. This was well shown by Braasch and Thomas who in 1914 reported the results of the phthalein test in 168 cases of prostatic hypertrophy. After calling attention to the impossibility of selecting any fixed percentage output as the operative danger line, they mention a 20 per cent. output in two hours as the low level of even comparative safety at which operation may be undertaken. They then mention a number of cases with a low percentage output of phthalein that recovered and a number with a high percentage output of the drug that died after prostatectomy. There were eleven patients in the series whose kidneys eliminated less than 20 per cent. of phthalein. All of these patients recovered after removal of the prostate except one whose death resulted from cardiac failure. In two instances patients whose kidneys secreted only a trace of phthalein in two hours recovered promptly from operation. Several cases in this series with normal percentage outputs for the two-hour period died of uremia following prostatectomy.

These observations have been fully confirmed in our experience. One of our patients, a man aged 69 years, who had a phthalein output persistently below 17 per cent. recovered promptly after prostatectomy; another on admission to the hospital had a phthalein output of 29 per cent. which gradually dropped to 12 notwithstanding marked improvement in the general physical condition; this patient had an uninterrupted operative convalescence. A third patient with a phthalein output of 52 per cent. promptly died of uremia after operation; a fourth, aged 72 years, with a phthalein elimination of 78 per cent. died in uremic coma after prostatectomy. These results with the phthalein test have occurred in our experience with comparative frequency. Nevertheless they must be considered exceptions to the general rule

that this test usually gives an accurate index of kidney function. The test is without doubt of prognostic value; its value is much enhanced by comparison with the blood urea content.

Illustrative of the value of the phthalein test in gauging the improvement in kidney function with treatment is the case of a patient who was admitted to the Lankenau Hospital on 5–11–15 with a total failure of phthalein elimination; next day the percentage output was 10; four days later it reached 21 per cent. and five days later it had risen to 30 per cent. The prostate was then removed and the patient promptly recovered.

The Mayos are of the opinion that the patient's general condition is more important as a prognostic index than the results of the phthalein test, and that a stationary or decreasing phthalein output is not a contraindication to operation provided the general condition is improving. We, too, are guided largely by the general condition of the patient, but we must confess that a decreasing phthalein output when accompanied by a rising blood urea notwithstanding appropriate treatment, is looked upon by us as of serious prognostic significance.

Practically every individual, we repeat, demands treatment before operation. In every case there is a time when the maximum efficiency of the vital organs is reached. The correct interpretation of the various functional tests is a matter of experience. Such interpretation is not merely a mathematical formula, but depends largely upon clinical knowledge without which no surgeon can be a successful prostatectomist.

Tests of Retention aim to estimate kidney function by measuring the increase in the blood of substances that should have been eliminated by the kidneys. Practically all of the ash of protein derivatives and non-protein nitrogen is eliminated by the kidneys. Failure of renal function is quickly followed by accumulation of these substances in the blood. A concentration of urea, 0.5 grams, and of the total incoaguable nitrogen, 0.6 grams per litre of blood, have been the accepted normal level, but Folin and Dennis have found that a concentration of non-protein nitrogen, 26 mg. and urea nitrogen, 13 mg. per 100 grams of blood, is the normal concentration.

According to Geraghty "no great prognostic significance can be attached to concentrations less than 0.55 gms. per litre. Increase in the content of blood urea is not always found in nephritic men in the presence of impending uremia, while an increase in the nitrogen content of the blood is found in diseases other than nephritis. With this,

as with other tests, there are therefore notable exceptions that, unless recognized, will negate the value of the test as a practical aid in the diagnosis and prognosis of kidney disease."

Urea exists throughout the body in practically the same concentration. In the normal individual it is delivered to the kidneys in a definite concentration which latter depends almost exclusively upon the protein content of the diet. Normally urea constitutes about one-half of the solids in solution in the urine, about 30 gm. being eliminated by the kidneys of a healthy individual in twenty-four hours.

According to Folin the urea is produced from the products of proteid digestion by the liver whence it goes to the blood to be eliminated by the kidneys without entering into tissue formation. Obviously the influence of diet is most important. Mosenthal and Lewis call attention to bodily tissue destruction in diseased states as a cause of blood urea accumulation. This factor must be taken into account when estimating the concentration of urea in the blood, especially in cases where an adequate degree of renal failure cannot be demonstrated by the phthalein and other tests to explain it.

The total kidney function cannot be determined with accuracy by measuring the urea content of the urine. Ambard's constant, however, which is based on laws governing the proportionate amounts of urea in the blood and urine of healthy individuals is considered by many, and especially by French urologists a reliable means of estimating kidney function. This method has not gained in popularity in this country, nor has cryoscopy met with much favor among American urologists. In our own clinic, and this applies we believe, to most of the clinics in America, the test of retention most frequently employed, and the one on which most reliance is placed, is the estimation of the urea nitrogen in the blood. Urea constitutes about 70 per cent. of the total nitrogen of the blood and variations in its concentration are associated with parallel variations in the total non-proteid nitrogen. As mentioned, above a concentration of urea 13 mg. per 100 cc. of blood is said by Folin and Dennis to be normal.

The urea test, like all other laboratory tests for renal insufficiency, is merely an adjunct to the diagnosis and prognosis. All laboratory tests, which are of great value when properly interpreted, may be productive of gross errors if clinical experience and common sense are not used liberally in their practical application.

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CHAPTER IX

PROGNOSIS

A question of considerable importance and much interest in connection with enlargement of the prostate is that of prognosis. In few other diseases is it so necessary for the surgeon to know what may be accomplished by the various methods of treatment, and in probably no other class of cases is he more severely blamed for errors in judgment. It is not sufficient, indeed it is neither ethical nor humane, to hope that the patient will die of some intercurrent affection before any necessity arises for instituting active treatment on behalf of his enlarged prostate; and hence every physician or surgeon who has such cases under his charge must give careful thought and attention to each individual patient, and must know whether the expectation of life will be lengthened or decreased by the treatment he proposes, or whether the certainty of a life of considerable discomfort for a rather prolonged period is not less to the patient's ultimate advantage than the immediate risk of life incurred by a somewhat severe and shocking operation, which, if successful, will enable the patient to live out his natural term of life in ease and comfort.

There are, then, two main questions to be solved in this connection: first, whether the patient's life can be saved, prolonged, or at least not sacrificed by the treatment to be pursued—that is to say, the question of mortality; and, second, whether the patient's sufferings will be relieved wholly or in part, or whether no change at all can be obtained—that is, the question of final functional results.

Under medical treatment and catheterism there is practically no possibility of directly terminating the patient's life; with the understanding that every antiseptic precaution be taken in catheterization, his life may even be prolonged, and in certain cases made very comfortable. Many a patient who has to pass a catheter only once or twice in the twenty-four hours will live a life of perfect ease, and will round out his days without interruption. But where the catheter has to be passed frequently—that is to say, as often as four to six times in the twenty-four hours—or where its passage at even longer intervals is attended with pain or difficulty, catheterism must be considered at the present

day an insufficient remedy, except in those who are already on the threshold of the grave. The expectation of life, moreover, in patients treated by catheterization, has been shown by Harrison and by Lydston to be, on the average, no more than four or five years; so that it is clear that the life of the average patient is shortened by such treatment.

Squier of New York states that 50 per cent. of unoperated patients will die within five years from the time of onset of obstructive symptoms where catheterization is unnecessary. The institution of catheter life, he adds will shorten the expectation of life to two years and eight months on the average and increase the mortality to 62⅓ per cent. within the shortened period.

We have a patient who has carried an in-lying catheter for 9 years. He continues very well. During this time absolutely no urine has been passed, except by catheter, and there is but a mild grade of cystitis.

The next mildest form of treatment is drainage of the bladder. By this means may be obtained relief of the cystitis, and consequently of the tenesmus, pain, and general unrest, in a certain number of cases. In our opinion, it is applicable chiefly to those in a very debilitated condition, or to the very old. Drainage by a permanent catheter introduced through the urethra can seldom long be endured, and is usually only to be employed in preparing the bladder for a radical operation. The successes of Thompson, McGuire, and others in treating these patients many years ago by means of suprapubic permanent drainage, and of Harrison by means of a perineal tube, should not be forgotten at the present day; and while we recognize the inadequacy of such methods to restore the patient to his normal condition, yet in a limited number of cases they are still useful. Especially is this so in patients with very bad cystitis, and where some immediate relief is imperative. In such cases so radical an operation as prostatectomy will almost surely kill, unless time can be obtained to relieve the cystitis, to get the kidneys into fair condition, and to improve the general health of the patient.

In such patients, the two-stage operation is the method of choice. In some few instances it is necessary to form a permanent suprapubic fistula and then drain the bladder for a prolonged period of time before attempting the removal of the prostate. Rarely indeed, do we find it impossible to complete the final stage of the operation with comparative safety to the patient after preliminary drainage of the bladder.

Primary Mortality.—It is the concensus of opinion among surgeons that the primary mortality rate is slightly less following perineal

prostatectomy than that following the suprapubic operation. In this opinion we concur notwithstanding the fact that our collected series of cases fails to confirm this long accepted belief. These statistics are collected from many sources and include the results of operators of both great and small experience. Undoubtedly the primary mortality rate is much or more dependent upon the care with which cases are selected for operation, and upon the thoroughness with which pre-operative treatment is carried out than upon the type of operation selected or the skill of the individual who performs it. Our list includes approximately twenty-five hundred cases but does not include the published statistics of the recognized leaders in suprapubic and perineal prostatectomy. We have purposely omitted the results of the work of these few men for the reason that we are now attempting to ascertain the average mortality of the operation of prostatectomy as it is performed throughout the country.

There exist only slight differences in the operative mortality following the two types of operations in the hands of the most experienced men. The suprapubic operation is a much safer procedure for the occasional operator than the perineal prostatectomy, as is well illustrated by the much higher mortality rate for the latter operation as reported by surgeons working in smaller communities.

Freyer has recently reported a series of 1550 suprapubic prostatectomies with a general mortality of 5.33 per cent. The death rate among the first hundred cases in this series was 10 per cent. while among the last two hundred cases it has been only 3 per cent. Young's mortality rate with the perineal operation is slightly less than 4 per cent. In our collected series of cases the death rate following the perineal operation is 10.9 per cent. in contrast to the 6.9 per cent. mortality succeeding suprapubic prostatectomy. Although fully cognizant of the unreliability of most statistics, we are inclined to believe that these figures express in a general way the relative dangers of the two operations in the hands of the average surgeon. Statistics collected from other sources would undoubtedly yield different results, but we believe that these figures are correct. If the cases operated upon by the more experienced men among the group who were good enough to furnish us the data, *i.e.*, if all series of one hundred or more cases are eliminated from the calculation, the average mortality rate immediately rises to between 20 and 30 per cent. The latter is in keeping with the figures of Page, who reports a mortality rate of 21.5 per cent. for four London hospitals between the years 1906 and 1910.

During this same time sixty-nine suprapubic prostatectomies were performed in St. Thomas's Hospital with a mortality rate of 20.3 per cent. Wade gives the astonishing information that the mortality rate in one of the largest hospitals of Scotland for a ten-year period was 35.4 per cent.

Suprapubic Prostatectomy

Operator	Number of cases	Mortality (per cent.)
Gile	24	46.0
Tenney and Chase	396	9.8
Deaver (collected series)	1734	6.9
Freyer	1550	5.33
Dillingham	85	2.4
Watson	50	12.0
Kelley	75	20.0
Watkin	60	10.0
Scherck	150	8.0
Denslow	200	6.0
Gardner	218	4.1
Walker	112	5.0

Perineal Prostatectomy

Operator	Number of cases	Mortality (per cent.)
Gile	38	10.5
Deaver (collected series)	676	10.9
Dillingham	15	6.6
Watson	110	6.3
Kelley	150	10.0
Watkin	100	3.0
Scherck	20	20.0
Gardner	84	19.0
Young	450	3.77
Legueu (collected series)	1026	8.0
Tenney and Chase (collected series)	617	7.6

A most interesting study of the subject now under discussion has been made by Whiteside, who in 1905 presented a paper before the Section on Genito-Urinary Diseases of the American Medical Association in which he stated that the average mortality following prostatectomy was 20 per cent. and with only 30 per cent. of cures. In a second paper presented ten years later (1915) before the same association, he reviews

the work of thirty-four surgeons giving data on 1423 cases including his own cases. In the latter series about half of the surgeons contributing more than half (820) of the 1423 cases were men experienced in either the suprapubic or the perineal operation. The primary mortality rate was less than 3 per cent. in the hands of these men while in the hands of the inexperienced it was 26 per cent.

Causes of Primary Mortality Following Prostatectomy.—The chief dangers of the operation which frequently cause the immediate post-operative death of the patient are in their order of frequency in our collected series as follows:

Causes of death	Number of cases
Uremia	39
Hemorrhage	32
Shock	18
Sepsis	13
Cardiovascular	10
Pyelitis and pyonephrosis	8
Asthenia	7
Pulmonary	6
Embolus	5
Diabetes	3
Extravasation of urine	2
Acute dilatation of stomach	2
Air embolus	1
Intestinal paresis	1
Total	147

These figures indicate that 69 per cent. of all deaths following prostatectomy are due either to uremia, hemorrhage, shock or sepsis. The relative incidence of the causes of death, as given in the foregoing tabulation, is contradicted by some writers in whose experience sepsis is the most frequent cause of death after the suprapubic operation. In almost all of the larger series of collected statistics whether dealing with the suprapubic or the perineal operation, uremia is placed at the head of the list of lethal factors. The unusually high percentage occurrence of fatal hemorrhage in our series is difficult to explain except on the basis of imperfect hemostasis, in other words, an inexcusable fault in technique. Freyer does not mention hemorrhage as a cause of death in any of the fifty-seven fatal cases among a series of 1036 suprapubic prostatectomies reported in 1913.

Causes of Death After Prostatectomy (Freyer)

Causes of death	Number of cases
Uremia	24
Heart disease	9
Shock	7
Exhaustion	3
Septicæmia	3
Mania	2
Malignant disease of liver	2
Bronchitis	2
Pneumonia	1
Heat stroke	1
Pulmonary embolus	1
Cerebral hemorrhage	1
Acute pancreatitis	1
	57

The following table gives in their order of frequency, the causes of death in a series of 36 fatal cases of suprapubic prostatectomies operated upon in the Lankenau Hospital of Philadelphia.

Causes of Death following Prostatectomy (Lankenau Hospital, Philadelphia)

Causes of death	Number of cases
Uremia	8
Pulmonary	7
Shock	5
Myocarditis	4
Sepsis	4
Asthenia	3
Peritonitis	3
Meningitis	1
Gastro-enteritis	1
	36

Tenney and Chase have given in the following tabulation the causes assigned for death in a series of forty-six fatal cases.

Causes of Death Following Prostatectomy (Tenney and Chase)

Causes of death	Number of cases			
	Within 48 hours		Within 12 days	
	Suprapubic	Perineal	Suprapubic	Perineal
Uremia	2	5	9	9
Shock and hemorrhage	4	1	4	2
Pulmonary	2	0	5	1
Sepsis	0	2	1	3
Cardiac	2	2	2	3
Collapse	0	0	1	2
Anesthesia	1	2	1	2
Unknown	0	0	0	1
Total	11	12	23	23

Pauchet, who strongly advocates the two stage operation, mentions infection, renal insufficiency, and narcosis as the prominent causes of death. He reports four series of one hundred cases each, with a mortality rate as follows:

First one hundred cases	10.0 per cent.
Second one hundred cases	8.1 per cent.
Third one hundred cases	6.5 per cent.
Fourth one hundred cases	4.0 per cent.

This progressive improvement Pauchet attributes to improvement in operative technique and to better pre-operative and post-operative care of patients. The two-stage operation finds a strong champion in this writer who advocates preliminary cystostomy from three weeks to several months in advance of the prostatectomy, according to the exigencies of the case. A prominent feature in the technique is the care with which opening of the space of Retzius is avoided to prevent pelvic cellulitis which, in Pauchet's opinion, is a frequent predisposing factor to fatal infection. The use of local anesthesia for both the perineal and the suprapubic operations and section of the vasa deferentia in aged patients to prevent epididymo-orchitis, which may become a lethal factor after prostatectomy, especially in debilitated subjects, are other features outlined in this valuable paper. The means of pre-operative disintoxication of the patient and of eliminating the effects of narcosis are described in detail.

In reviewing any series of fatalities following prostatectomy, it will

be noted that there are certain fatal periods, a fact to which attention has already been drawn by Tenney and Chase, whose observations in a larger series of cases concurs, for the greater part, with our own. In their series of 73 fatal cases there were twenty-three deaths during the first forty-eight hours after operation, twelve deaths occurring during the seventh, eighth, and ninth days after operation; while the third fatal period is that at the end of the second week when six deaths occurred. From the twentieth to the twenty-second day, inclusive, there were seven deaths. Two-thirds of all deaths occurred during these fatal periods.

Among the most distressing and usually unavoidable accidents after prostatectomy are cerebral embolism and apoplexy which often cause the death of a convalescent patient already fully recovered from the operation and about to be discharged from the hospital. These accidents are fortunately rare. A not inconsiderable number of patients die within the first year after leaving the hospital of causes that are directly or indirectly attributable either to the operation or to the progressive development of complications that existed at the time of operation and which the latter failed to cure. Thus we find that 4.2 per cent. of the patients in our collected series upon whom perineal prostatectomies had been done died within one year from the time of their discharge from the hospital while 2.5 per cent. of the suprapubic cases died during this same time interval. The operation in these cases was obviously of little avail in prolonging life. Unfortunately we have no data regarding the state of the patients' health and comfort during this brief post-operative period.

The late results of prostatectomy are well shown and, we believe, with comparative accuracy in our series of which we have obtained the end-results in 372 perineal and in 814 suprapubic prostatectomies, of which seventy per cent. and seventy-six per cent. respectively, are reported as completely cured. Seventy-eight per cent. of the perineal cases and 79.4 per cent. of the suprapubic cases were alive and free from bladder symptoms two years after operation. Of the patients operated upon in our clinic seventy-two per cent. are alive and well two or more years after operation and eight per cent. are living, but are not completely cured.

In a most instructive and valuable paper, Judd has given the results of 542 prostatectomies performed in the Mayo Clinic prior to April 1, 1911. Of these, 461 operations were performed for benign hypertrophy of the prostate, seventy-four for cancer, and seven for tuber-

culosis of this organ. The series includes a number of partial prostatectomies, and the results obtained are excellent, especially in view of the fact that these operations were performed in what must now be looked upon as the comparatively early days of prostatic surgery.

Sixty per cent. of the entire series were "living and enjoying reasonably good health" at the time of this report. Fourteen patients in this series returned for the removal of vesical calculi; twenty-nine died from kidney disease before the end of the second post-operative month; eighty-one patients died after leaving the hospital and of these thirty had carcinoma and twenty died of some intercurrent disease not related to the urinary system.

A most interesting feature of this report is the record of autopsy findings in the twenty-nine cases of renal disease in all of which it was possible to demonstrate an acute nephritis superimposed on an old infection of the kidneys.

The physical condition of the individual is of major importance, the average result being of only relative importance when we are called upon to prognosticate the result of operation in a given case. However if the patient desires statistical information he can be assured that his chances in company with that of fellow sufferers for recovery from the operation are better than ninety per cent. and that the probabilities of continued life and entire comfort are better than seventy per cent. Seventy-two per cent. of our own patients are alive and well at periods ranging from one year to twelve years after the operation.

Predetermining Factors in the Mortality Rate of Prostatectomy.— Of the many factors that play an important part in determining the mortality rate of prostatectomy, *age*, *per se*, has relatively little influence. With increasing age the reserve powers of the vital organs naturally diminish so that the older the individual the less likely is he to withstand the shock of operation and the evil effects of confinement to bed. The aged man therefore remains a poorer operative risk for many reasons, the most important of which is his greater susceptibility to complications especially of the pulmonary and cardio-renal types. The effects of hemorrhage and infection are disastrous to the aged individual although operative shock unassociated with hemorrhage is borne with suprising success by very old men. Old age of itself is not a contra-indication to operation, many brilliant successes being obtained with the operation of prostatectomy in men between the ages of seventy-five and eighty-five years.

Decade Mortality Following Prostatectomy

Cases	Ages	Mortality, per cent.	Decade mortality, per cent.
8	39–49	0.0	
31	50–54	10.0	5.8
89	55–59	4.5	
201	60–64	7.0	
221	65–69	11.3	9.5
175	70–74	13.0	
65	75–79	18.5	15.0
24	80–84	8.0	
0	85–89	0.0	
2	90–94	50.0	

The above series would indicate that the death rate steadily increases with advancing years; which is probably the case, although it is not true in our personal experience since 37.7 per cent. of our fatalities occur in patients between the ages of seventy and eighty, while 39.6 per cent. of all fatalities occur in patients between the ages of sixty and seventy years.

As a general rule, the convalescence of very aged patients after prostatectomy is stormy in comparison with the smoother uncomplicated recovery of the younger individual.

The duration of the disease is an important prognostic factor, as are also the type of pre-operative treatment that the patient has been given and the local complications, such as acute urinary retention, from which he has suffered in the past.

These factors, however, together with more remote influences, including personal habits, occupation, previous diseases and the like, are of prognostic significance only in so far as they influence the organs and tissues upon the recuperative powers of which the recovery of the individual depends.

The post-operative complications leading to fatalities in prostatectomy are usually exaggerations of pre-existent disease usually of the kidneys; less often they are dependent upon technical errors in operative technique.

Complications of Prostatectomy.—In considering the complications which lead directly to a fatal result following prostatectomy we will pay special attention to the more common types and to those which are more or less peculiar to this condition.

Pulmonary complications, which stand eighth in our list of lethal

factors might, at first thought, be looked upon as a more common complication in these aged individuals. Undoubtedly they are more frequent than these figures indicate but they are, for the most part, congestive in type, and with proper treatment subside promptly. Pulmonary embolus is a rare cause of post-operative death. Diabetes which is given as the cause in three fatalities is a positive contra- indication to operation unless the disease improves markedly under medical treatment. The diabetic must be gotten into the state where wound healing can be anticipated with reasonable assurance and where there is only a remote danger of fatal acidosis supervening upon operation.

Cerebral hemorrhage cannot always be prevented, but an unusually high blood pressure and very marked arteriosclerosis are danger signals that must be heeded. Acute dilatation of the stomach, and intestinal paresis resulting from toxemia are rare though usually fatal complications of prostatectomy.

Much difference of opinion exists among statisticians as to the relative frequency of the prominent causes of death following prostatectomy. In our collected series of cases, renal failure and hemorrhage are by far the most prominent fatal complications of operation, while in our personal experience fatal bleeding has been exceedingly rare, indeed practically unknown since we began packing the prostatic bed with gauze in all cases where the hemorrhage is not arrested spontaneously soon after the enucleation of the tumor.

Pelvic cellulitis and wound infection are likewise rare factors in our fatal prostatectomies. Uremia, pulmonary complications and shock are the more common post-operative complications which present themselves to us. Wade, on the contrary, quoting the figures of Page, speaks of these as coinciding with his own and states that far and away the commonest cause of death is septic absorption arising from wound infection, and that renal disease occupies second place among the lethal factors.

The prognosis is undoubtedly influenced by the presence of a foul cystitis, not only as regards the primary mortality rate which is higher in this class of cases than in mildly infected ones, but also in respect to the likelihood of infectious complications such as pyelonephritis, epididymitis, pelvic cellulitis, and wound infection, or of embolic involvement of the lungs or of the venous system. Frequently associated with the infected cases are vesical calculi which have long been supposed to exert a favorable influence on the prognosis. This erroneous belief had been handed down from writer to writer until, with the collection of

large number of statistics its fallacy became apparent. In 1913 Freyer reported 190 cases of enlarged prostate complicated by calculus with a mortality rate of 8.42 per cent. as contrasted with a mortality rate of 4.84 per cent. among 846 cases unassociated with vesical calculus. Freyer, in his most recent contribution, reports 274 cases of enlarged prostate associated with stone, with an operative mortality rate of 7.25 per cent.; the general mortality rate in 1550 cases was 5.33 per cent. According to our figures stone is found in 9.8 per cent. of cases of enlarged prostate. In the belief of twenty-four of the thirty-four surgeons whom we consulted in the matter, the presence of stone has no influence whatsoever in prognosis. According to Tenney and Chase, who report 107 cases of prostatic hypertrophy complicated by stone in the bladder, the relative mortality of those with and without stone is as 12 to 8.6. These figures indicate the more hazardous nature of prostatectomy when vesical calculus complicates the prostatic disease, especially when the prostate and stone are removed through the perineum.

The least serious of the infectious complications, such as epididymitis, may be the deciding factor in causing the death of a debilitated subject. Every effort should therefore, be made both before, during, and after the operation to minimize the chances of bacterial growth and dissemination. Epididymitis may occur before the operation and especially after instrumentation, but more commonly succeeds it. McDonald has reported forty-five cases of epididymitis among 118 patients (27.5 per cent.), fourteen of which developed it before operation, twenty-seven while the patient was convalescing in the hospital after operation, and four in which this complication arose after the patients had been dismissed from the hospital.

It is indeed a distressing experience to have suppurative epididymo-orchitis necessitating orchidectomy occur in a patient prior to the operation of prostatectomy for which he originally entered the hospital. The condition is usually unilateral although infection of the opposite side may follow at varying intervals of time. It is advisable in patients who have badly infected bladders and a history of recurrent epididymitis, to expose the vasa at the base of the scrotum, remove a small segment from each one and ligate the ends before proceeding with the prostatectomy.

Phlebitis is a rare sequel of the operation and is usually not a serious one itself, although it may necessitate longer confinement of the patient to bed than would otherwise be necessary. Surface wound infection is more commonly met with, but is of little clinical significance

in comparison with infection of the deep wound of the prostatic bed. Serious infection is more likely to occur here following the suprapubic operation, as are also its fatal sequelæ, pelvic cellulitis and peritonitis. The latter is sometimes due to infection which gains entrance to the peritoneal cavity through an incision in the peritoneal membrane at the summit of the bladder; this must be carefully pushed away before the bladder wall is incised.

Cystitis itself is an unimportant complication of the operation, but is the fruitful source of bacteria which gives rise to much concern when transplanted to other and more fertile fields.

Among the more inportant of the infectious complications is pyelonephritis. Pyonephrosis when present has almost invariably existed prior to operation. These two infectious processes stand sixth in the list of fatal factors after prostatectomy. Chronic pyelonephritis is a common pre-operative complication of prostatic hypertrophy and is a prominent cause of the kidney destruction that so often results after operation in fatal uremia. This, as well as pyonephrosis with total unilateral renal destruction may easily be overlooked before operation, especially in cases where ureteral catheterization is impossible. However, with the aid of the various kidney functional tests, cromo-ureteroscopy and cysto-ureteropyelography, etc., these mistakes are now rarely made in well-organized clinics.

Acute post-operative pyelonephritis is rarely fatal if uncomplicated by pre-existent renal disease. The diagnosis and treatment of these conditions will be discussed in describing post-operative treatment.

The infectious complications of prostatectomy are, as we have already mentioned, of secondary importance as fatal factors. Far more important in this respect are the non-infectious complications which may conveniently be divided into two groups; namely—first, those dependent solely upon technicalities in the operation or the immediate constitutional effects arising from the operation, and secondly, those dependent upon vital functional alterations primarily induced by the operation but contributed to by pre-existent injury of vital organs. Prominent among the former group are hemorrhage and shock; of the latter group, renal insufficiency and cardio-vascular collapse are of major importance. A certain interrelation exists between these several conditions, but as a rule, one or the other overshadows all the rest in importance.

Hemorrhage, either immediate or delayed, is a rare cause of death

following prostatectomy in our experience, although the majority of cases of fatal shock are due in part at least to loss of blood.

A safe practical rule is to make sure that all gross bleeding is arrested before the patient is sent from the operating table. In all doubtful cases where bleeding continues despite the usual efforts to stop it, it is our practice to pack the prostatic bed with gauze which is held in position by means of a purse string suture placed around the margins of the prostatic bed on its vesical side. In the event of marked bleeding occurring soon after the patient is sent to the ward, no time should be lost in returning him to the operating room, re-opening the bladder, and packing or repacking the prostatic bed.

Hemorrhage may occur later in the course of an otherwise normal convalescence and is then either a true secondary bleeding which has resulted from sloughing in the prostatic bed, or is a result of trauma incident to the removal of the packing. Whiteside reports two cases of fatal bleeding due to the passage of the rectal tube several days after prostatectomy; the Murphy drip is therefore, he thinks, not entirely without danger. Certainly the tube should be introduced with great care and gentleness. We have seen bleeding follow the giving of an enema. Secondary hemorrhage occurs, as a rule, during the latter part of the first week of convalescence; it is rarely alarming. The blood is discharged both by way of the suprapubic wound and *per urethram.* Only in the rarest instances is it necessary to re-open the bladder to stop late secondary hemorrhage. Rather profuse bleeding follows instrumentation in some instances as late as the fourth week after operation; it is rarely alarming in amount. Every effort should be made to minimize the amount of blood lost during a prostatectomy, inasmuch as this class of patients already debilitated by age and infection can ill afford to lose even small amounts of blood.

Uremia usually comes as the result of the added strain incident to anesthesia and operation on kidneys already injured. This is the commonest cause of death after prostatectomy (26.5 per cent.). In some instances the pre-operative studies have shown a good functional reserve power of the kidneys notwithstanding which the patient dies in uremia following acute suppression of urine. For these cases which are fortunately rare, there is little hope of predetermining the condition or of restoring kidney function once it has completely failed. The condition is due to acute congestion of the renal parenchyma with total inhibition of function. By far the greatest proportion of post-operative uremias are dependent upon renal insufficiency which is caused either by an

antecedent chronic interstitial nephritis or by infectious pyelonephritis or pyonephrosis.

It is in this class of cases and especially in those due to infectious causes that careful and often prolonged treatment is necessary before operation can be undertaken with safety. Indeed, no case of prostatic hypertrophy should be operated upon until the maximum reserve functional capacities of the kidneys are determined, and this can only be accomplished through decompression of the kidneys either palliatively or by cystostomy.

The cardiovascular complications stand fifth in the order of frequency among the causes assigned for death in our collected series of cases. Many of these cases would have in all probability been saved had they received appropriate pre-operative treatment. Chronic lesions of the heart, if compensated for, need cause little or no concern, although it is not always possible to detect the degree of myocardial degeneration present; acute dilatation of the heart is therefore bound to supervene in a certain small percentage of cases. It is ordinarily a fatal complication. In asthenic cases with poor circulatory activity much may be accomplished before operation by rest and the use of heart tonics. Excessively high blood pressure is a contra-indication to operation unless it is clearly a compensatory measure; under all circumstances it must be taken into account in the selection of the anesthetic, the choice of the method of operation, and in the pre-operative and post-operative care of the patient.

The question of malignancy does not play a direct part in the primary mortality rate for the reason that early cases of cancer of the prostate recover from operation quite as well as the cases of benign hypertrophy. We are referring now to those cases in which the presence of cancer is not suspected before operation; indeed, in many instances, the presence of cancer is not suspected until the microscopic examination of the removed specimen is made. According to our statistics, this group comprises 7.42 per cent. of the total, so that this factor has some prognostic meaning.

Morbidity following The Operation of Prostatectomy.—It is extremely difficult to ascertain the average of complete cures attained by the operation of prostatectomy, but we believe a conservative estimate would fix the number of patients who are not completely cured by the operation, between twenty and thirty per cent.

The great majority of these are improved however; rarely is a patient's condition made worse by operation. An individual who has

suffered with complete urinary retention and has led a catheter life for some time and then submits to an operation which leaves him with a permanent urinary fistula in the perineum has certainly not benefited by the operation. Much has been written about post-operative urinary fistula, and while it is doubtless rare, it is a not unlikely complication of perineal prostatectomy. Wade, for instance, has collected 1423 cases of prostatectomy of both the perineal and the suprapubic types and among these there were fourteen instances of fistula (urethro-rectal) and twenty-four instances of complete incontinence, all of which followed perineal prostatectomy. Young reports only two instances of urethro-rectal fistula in a series of 482 perineal prostatectomies. Practically all other writers agree however that there is considerable danger of fistula following the perineal operation and use this as an argument in favor of the suprapubic operation. Judd favors the perineal route and has noted but few fistulæ in his work.

In our collected series of cases, fifty (2.9 per cent.) cases of fistula are reported as following the suprapubic operation, but ten of these are reported by a single individual who says that they all occurred before the high incision in the bladder wall was adopted. In thirty-five (5.3 per cent.) of 656 cases, fistulæ followed the perineal operation. Judd states that only six fistulæ occurred after 373 perineal prostatectomies, fifty per cent. of which were performed for carcinoma of the prostate and that in four instances, the perineal wound had completely closed and then re-opened.

In the hands of the expert prostatectomist, a permanent fistula is a rare complication of either the suprapubic or the perineal operation, but even in the hands of the most expert, it has a greater incidence following perineal prostatectomy.

In our series, ten vesico-rectal fistulæ are reported as having followed the perineal operation.

Incontinence of urine in the absence of fistula may follow both the suprapubic and the perineal operation, but is far commoner after perineal prostatectomy. True incontinence may exist prior to operation, although the dribbling of prostatics is commonly an overflow of retention. True incontinence is sometimes improved by operation, but may be made worse; at all events, prostatectomy should never be undertaken on a patient with incontinence until tabes is ruled out by a complete neurological examination and examination of the spinal fluid. Cystoscopic examination is especially indicated in this group of cases.

The mechanism of bladder control both normally and after prosta-

tectomy is discussed in the chapter on physiology to which the reader is referred. We are here more particularly interested in the frequency of this distressing complication. Not one case of complete incontinence is said by Young to have occurred in a series of 331 perineal prostatectomies, and only three had partial incontinence. In our series of suprapubic cases this complication is mentioned forty-six times (2.6 per cent.), but of these forty are said by one correspondent to have occurred among seventy-five patients. We have not had the opportunity to verify these figures. In thirty-six (5.1 per cent.) instances, incontinence followed the perineal operation. The figures of Whiteside who reports twenty-four cases of urinary incontinence, all of which followed perineal prostatectomy, are given elsewhere.

Complete retention of urine occurred five times more frequently after the suprapubic than after the perineal operation in our series, of which latter only two were followed by complete inability to void. Four instances of complete retention followed 482 perineal prostatectomies reported by Young.

About eight per cent. of all patients continue to show residual urine after operation. Frequency of urination is commonly experienced after operation, but this improves steadily and with the complete healing of the prostatic bed disappears, often entirely. The presence of small amounts of residual urine, a mild cystitis, or an interstitial nephritis are the common causes of the nocturia with which many patients are troubled after operation.

Prostatism, with or without complete retention, following suprapubic prostatectomy is due usually to the presence of tabs of mucosa so situated as partly, or completely, to obstruct the vesical outlet; in perineal cases, contracture of the vesical neck commonly explains urinary retention succeeding operation.

The question of sterility following prostatectomy is usually unimportant, but the surgeon is frequently questioned by the patient concerning the probable effect of the operation on his sexual powers. If loss or gradual failure of the latter has occurred, the patient is interested in the ability of the operation to restore his waning powers to normal. To this it is proper to answer that in all likelihood no improvement will follow the operation. In certain instances however, potency has been restored after the suprapubic operation. This is difficult to explain except on the grounds that the relief of pressure from the displaced ejaculatory ducts permits the re-establishment of the normal reflex.

The possibility of the loss of sexual power through the operation is

of great concern to many patients, but this seldom occurs after the suprapubic operation. It is more likely to follow perineal prostatectomy, although preservation of the ejaculatory ducts and the zone of the urethral floor surrounding and including the verumontanum is said to preserve sexual potency. Upon this belief is founded the conservative perineal prostatectomy of Young, who has given in detail the effects of perineal prostatectomy on the sexual powers of 351 individuals. Among 133 patients whose sexual powers were about normal before operation, seventy-eight (59 per cent.) stated that there was a complete return of sexual powers, while one hundred (75 per cent.) stated that erections returned after operation. In twenty-four cases (18 per cent.) there was complete and permanent loss of sexual power. This is a greater proportion by far than follows the suprapubic operation.

One of the rarer of the late complications of prostatectomy is the occurrence or recurrence of calculi situated either in the bladder or in the prostatic pouch, or rarely, in both positions. This in our experience occurs in less than one per cent. of cases, although Judd reports fourteen instances among 542 cases.

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CHAPTER X

TREATMENT: CONSTITUTIONAL; CATHETERISM; PREVENTION OF COMPLICATIONS; AND TREATMENT OF COMPLICATIONS

Patients afflicted with enlargement of the prostate should preserve their health by making everything in their life subservient to regularity and temperance. By regularity we mean the avoidance of anything which is not habitual; there should be no exceptions to the amount of sleep, to the hours of meals, to the daily constitutional walk, to the hour of retirement, to the distance travelled, to the quantity of food and drink, to the amount of intellectual labor, or to anything which arises in a man's life. And temperance is epexegetical of regularity: not only should everything conjoin to allow the patient to pursue the even tenor of his way, but there should be moderation in all things; his habits should embrace the happy medium in which alone the path of safety lies.

Such habits as these are possible only for the man who is in easy circumstances. The day-laborer, the overworked artisan, who knows not in the evening whence will come the money to buy the morrow's bread, cannot, if he would, lead a life of such orderly quiet as is enjoined on his more fortunate neighbor. And it is only where this life can be led that the purely palliative treatment can be expected to render the patient comfortable. Where it cannot be pursued, radical treatment is urgently demanded to restore the individual to his former condition of independence.

1. Constitutional Treatment. (a) Hygienic Treatment.—Regularity and temperance being our watchwords, they are to be applied to every aspect of the individual's life. If possible, suitable climatic conditions should be obtained, the cold winters of the north being avoided by sojourns in lower latitudes. The patient's clothing should be warm enough to avoid chilling at all seasons of the year. Flannel in cold weather, and silk in hot weather, should be worn next the skin. Especially important is the avoidance of wet feet. Waterproof shoes should be worn, or sandals of rubber should be constantly carried in the overcoat pocket, ready for use in any emergency. Of more value even than these precautions, oftentimes, is the invariable rule to change the shoes

and stockings immediately upon the return from being caught in any dampness, no matter how trivial it may appear. Even if the feet do not feel wet, it is a safe precaution to change the shoes and stockings as a matter of habit. A very slight ischemia of the cutaneous circulation may bring on alarming prostatic, vesical, and renal congestion, with retention of urine and even uremic symptoms in a very short space of time; and of no conditions than these is it more true that an ounce of prevention is worth pounds of cure. It is less dangerous to become overheated than to be chilled, provided chilling is not the consequence of becoming overheated. To perspire freely is good for these patients; and for the purpose of aiding the excretory action of the skin regular bathing should be enjoined, provided it can be done in a well-heated and ventilated bath-room. It will be found safer with patients of advanced age to depend on moderate sweating, followed by a carefully administered sponge bath, or even on merely rubbing the skin dry, where an attendant cannot be provided for bathing, than to risk exposure in a poorly appointed bath-room. The water should be warm; if kidney disease is present hot baths are a valuable adjuvant in securing proper excretion of the waste products. Cold baths are to be condemned.

Hot sitz baths immediately before retiring are very grateful in some cases.

The bowels should be regularly opened at least once each day; and even if they act normally, the use of a brisk saline cathartic is to be enjoined at least once a month. Straining in defecation causes general pelvic congestion, and this reacts unfavorably on the prostate.

The urine is never to be retained beyond the accustomed period of three or four hours during the day. Holding it longer will be very apt to render the patient unable to evacuate it when be finally makes the attempt. The bladder is to be scrupulously evacuated as the last thing just before getting into bed. If the patient is forced to urinate during the night, it is better for him to use a urinal without leaving his bed, and thus avoid exposure and unnecessary exertion. Of course, where the patient is unable to make his water in the supine position, he will usually have to leave his bed entirely for this purpose. Socin and Burckhardt condemn the practice of urinating in the supine position, stating that the extra straining thus necessitated predisposes to atony of the bladder. The patient may try, at all times of the day, to urinate in the knee-chest position, so as, if possible, to overcome the retroprostatic pouch by the aid of gravity.

The patient should, on the other hand, be discouraged from passing

his urine unnecessarily often. With a bladder not markedly diseased it should seldom be imperative to evacuate less than 180 or 240 cc. of urine at a time.

Six to eight hours is enough for a patient to spend in bed at night. If more sleep is required, a nap may be taken in the daytime. He should not sleep long in the same position, changing after an hour or so from the back to one side, and again to the other, so as to avoid congestion of the vesical neck and prostate. Where exercise cannot be taken, massage is an invaluable substitute.

His daily occupation should be such as does not require exertion either constantly in mild degree or occasionally to excess. It should not interfere with his meal hours, nor by causing mental worry or fatigue interfere with his repose at night. He should "go softly all his days."

(b) Dietetic Treatment.—Certain articles of diet are notoriously unwholesome even for the healthy man, but in addition to eschewing these, the prostatic should likewise avoid certain edibles usually regarded as harmless. Vegetables of all kinds are permissible, and meats in moderation. The frequent association of kidney disease makes poultry a more suitable animal food than butcher's meat. Of this latter food, especially to be avoided are pork, ham, sausage, veal, and to a less degree beef. Stewed sweetbreads, boiled fish, stewed or raw oysters, are wholesome articles, and may largely replace meat. Clams and crabs are very unsuitable. Eggs and cheese are to be partaken of with caution.

Potatoes should be taken sparingly; green vegetables, provided they do not upset the stomach, are to be allowed liberally, as they tend to keep the stools soluble. Spinach, cauliflower, asparagus, stewed celery, squash (marrow vegetable), and similar vegetables are the best. Tomatoes, peas, and beans are to be allowed only occasionally, and in great moderation. Corn is not to be taken at all. For solid food nothing is as suitable as well-boiled rice. Cereals of all kinds may be given, especially barley; also wheaten and rye bread, but never hot, nor in any amount when fresh.

Salads and highly seasoned gravies and sauces are to be avoided, although lettuce or even fresh celery, with French dressing, may be occasionally indulged in.

Of fruits, the most suitable are prunes, rhubarb especially when stewed without much sugar; grapes, oranges, lemons, pears, and apples, in moderate quantities may serve occasionally to vary the monotony.

Figs, bananas, peaches, blackberries, strawberries, and raspberries are harmful in the order named.

Almost any kind of milk dessert is permissible, including tapioca, sago, rice and bread puddings, as well as ice-cream.

Great abundance of fluid should be taken, except, of course, where, from renal complications, polyuria is the most distressing symptom. Water is, of course, the most valuable beverage, and the most constantly palatable; and is probably of quite as much value uncarbonated and in its natural state. But the various alkaline waters may do good where the urine is acid and the diathesis gouty. The drinking of milk is to be especially encouraged. Alcoholic beverages are best avoided altogether; but here, as elsewhere, we think that long-continued habits should not be rudely disturbed, and prefer to allow our elderly patients to continue the very moderate use of whiskey with their meals, as in such quantities, and for such patients, it acts as an undeniable aid to digestion. Whiskey when good, is probably, the least harmful form in which these patients can take alcohol; the light Rhine wines also, Hock, Moselle, and others, may be taken, but Port and Madeira are to be studiously avoided. Claret may be allowed in moderation. An excess of sugar throws hard work on the kidneys and the bladder, and predisposes to urinary fermentation. Tea is better than coffee, and coffee than chocolate; but none of these beverages should be taken more than once a day, and then in the morning, and with a liberal dilution of milk or cream.

Food should not be partaken of late at night; if possible, dinner should be the midday meal. No fluid should be taken during the evening nor on retiring for the night. Patients often find themselves able to sleep the night through without urinating if this rule is observed. Yet in some gouty patients where the urine is much concentrated, a glass of water drunk just at bed-time will, as remarked by Moullin, by diluting the urine and rendering it less irritating, have the same effect.

(c) **Drugs.**—Very few drugs are of any permanent service in enlargement of the prostate. Tonics are usually indicated for the general health; and of these we would recommend the time-honored combination of the tincture of nux vomica, with dilute hydrochloric acid and some simple bitter, such as the compound infusion of gentian, as being as suitable as any other prescription. Strychnine itself does not seem always to have the same happy effect on the stomach that the tincture of nux has, and unless the heart demands training we usually prefer the tincture.

As already mentioned, an occasional cathartic is useful in every case; but many patients are habitually constipated, and must, even in addition to a diet carefully selected for this purpose, take a laxative almost constantly. For this purpose we are in the habit of employing either pills of aloin, belladonna, and strychnine, or, preferably, if the patient will take it, the fluid extract of cascara sagrada (Rhamnus Purshiana, U. S. P.). These remedies should be commenced in active doses, and the amount taken reduced, as soon as may be, to the least possible required to produce the desired effect. Some patients can keep their bowels happily regulated by chewing senna leaves or rhubarb root, of which they become almost fond in time. Compound licorice powder is another favorite remedy with some. Enemata of cold water may be useful in stimulating the lower bowel and in decreasing the pelvic congestion. Iodoform or glycerine suppositories may be employed in preference to injections; or ichthyol, locally, or by mouth, ten drops in a capsule three times daily. The patient will usually learn what form of medication suits him best, and will after experiencing a few times the discomforts of constipation and hemorrhoids, be very eager to avoid their recurrence, by properly regulating his diet and medicines.

The tone of the bladder is best maintained by preventing overdistention. Atropine should never be given long at a time; hence the preference expressed above for cascara sagrada over the use of A. B. & S. pills. Strychnine in one form or another is about the only drug which seems to have any influence on the contractility of the bladder; and as in the form of the tincture of nux vomica it acts favorably on the stomach, the intestines, the bladder, and also the heart, is probably the most useful single drug we have. Its prolonged use, however, is injurious, patients becoming nervous and fidgety when it is persisted in. The dose should not, as a tonic, exceed one and a-half mg. three times a day; usually one mg. is sufficient, except, of course, where stimulation is required.

For the heart, besides strychnine, as recommended above, an occasional course of digitalis will be found beneficial. This drug also increases the amount of urine excreted by increasing the forward pressure in the kidneys, and to flush these organs out it is at times an invaluable remedy. It should never be continued long, both on account of its cumulative action and the danger which always exists of exciting an intractable gastritis. The kidneys are best controlled by diet, no drug being of any lasting benefit.

For the prostate itself there is no specific. We are, however, firm believers in the occasional value of ergot. During an accession of prostatic and vesical congestion, often accompanied by an attack of piles, and with retention of urine, there are few prescriptions which afford the patient such comfort after the urine has been evacuated by catheter, as the following:

℞.	Ext. Rhamni Purshian. Fl.	15 cc.
	Ext. Ergotæ Fl.	39 cc.
	Ext. Hamamelis Fl.	45 cc.

M. S.—Teaspoonful three or four times daily, in water.

For the urine there are many drugs. It is readily diluted by increasing the amount of fluid, especially water and milk, ingested; and may be concentrated by withholding fluid and promoting perspiration. Boric or benzoic acid will be found useful for alkaline urines, and may be given separately or combined, about 300 mg. of benzoic acid being prescribed with double the quantity of sodium borate, to insure solution. Salol is an excellent urinary antiseptic, and with boric acid, may be employed for considerable periods—several weeks at a time—without producing injurious effects. Sodium benzoate is another good drug; urotropin, however, we prefer, when given with acid sodium phosphate. With piperazine we have little experience, and seldom employ it or the more irritating drugs, such as uva ursi, cubebs, buchu, and copaiba. For excessively acid urine the best remedies are a change in diet, especially a reduction in the amount of sugar, and dilution by an increase in the ingested fluid. The neutral or alkaline salts of potassium and sodium will usually be found to aid the change in reaction. The official solution of potassium citrate may be freely taken; and the alkaline mineral waters and purges may be advised.

2. Catheterism.—It is seldom justifiable to advise a trial of catheter life, or catheterism, as it is called.

This procedure shortens life by promoting infection of the bladder and kidneys and it should be advised only in inoperable cases.

As a means of preparing patients for operation the catheter is a valuable instrument; to prescribe its daily use as a substitute for operation is similar in principle to the administration of morphine in inoperable cases of carcinoma—it relieves the patient's suffering for a time but eventually fails to bring relief and almost inevitably shortens his life.

Certain individuals show little susceptibility to infection of the

urinary system, or having become infected, show surprising tolerance for the bacteria and their products.

These individuals not infrequently lead catheter lives for many years with little apparent harm. They, however, are exceptions to the general rule that death soon follows the institution of catheterism—about three years after, on the average.

Catheterism will cure no patients. Some individuals may have their symptom relieved, and be able to dispense with the catheter in the course of a few weeks; but such cases are probably those where the onset of the symptoms was due largely, if not entirely, to congestion of the prostate and its surrounding structures, and not to permanent obstruction from enlargement.

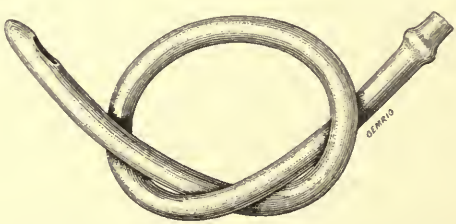

Fig. 59.—Soft-rubber Catheter (Nélaton). Natural Size of No. 21 of the French Scale.

But before entering upon the subject of catheterism in detail it will be convenient first to discuss the different varieties of catheters to be employed, and then their sterilization and preservation.

(a) **Catheters.**—Catheters are divided by systematic writers into the flexible, the semi-flexible, and the inflexible, of which four types, the Nélaton or soft-rubber catheter, the French coudé or bi-coudé woven catheters, English or webbed catheter, and the metallic catheter, are good representatives. The English catheter has the advantage that it can be worked into any shape giving a long prostatic curve and to suit the particular case. This instrument in our hands is more satisfactory than is the metal prostatic catheter.

The soft-rubber catheter, known by Nélaton's name, should for the purposes of prostatic surgery be 35 to 40 cm. long at the least. Its tip should be solid beyond the eye, and the eye should be moulded in the manufacture of the instrument, and not cut afterwards. By having the tip solid there is no space for the collection of filth, to act as a ready culture-medium for germs, and by having the eye moulded, not cut, there is the assurance that its edges will be smooth

and well turned, so that by no possibility can the urethra be damaged. The catheter employed should be new; and as soon as one commences to grow old it should be discarded. There is great danger of old rubber breaking and of leaving a portion of the catheter in the urethra or bladder, if it becomes brittle; and when it has become flimsy and collapsed it is exceedingly difficult to introduce.

The English catheter is made of webbing, covered with shellac, which renders its surface smooth, and gives a certain degree of rigidity to the instrument. These catheters are provided with stylets. Cheap English catheters are not worth buying: they are thin walled, break easily, or at least become creased, even when in the urethra, and are sometimes perforated by the stylet when in use. The tip of an English catheter is hollow like the rest of the shaft, and contains the end of the stylet. If the tip were solid, there would be constant danger of the stylet protruding at the eye, and thus lacerating the urethra. These catheters are of such consistency that when placed in hot or even moderately warm water they become limp, and can be readily moulded to any desired curve; and by the action of cold water they again become quite rigid, and will retain their form long enough for use. When not in use, they are kept on the stylet, which should be of the curve desired. As a rule, they are used without the stylet, but this may be allowed to remain in place if more firmness is required. When the curve requires to be altered during use, this is readily accomplished by partially withdrawing the stylet, as will be more fully described on a subsequent page.

The elbowed (*coudé*) catheter of Mercier is a very valuable instrument made of much the same material as the English catheter. Unlike the latter, however, the instrument of Mercier should have its tip solid; the beak is about eighteen mm. in length, and is set at an angle of 110 degrees with the shaft, which is straight, the eye being in the flexure between the two; or there may be one eye on each side of the beak. It is important to purchase only catheters of this variety where the angle is produced in the process of weaving, and to avoid those catheters, of which there are many in the shops, which have been woven straight, and which have had the end subsequently turned up. This latter variety is cheaper, but the elbow seldom is sufficiently pronounced when new, and very soon disappears altogether by the catheter resuming its original linear form. The catheter employed by Leroy d'Etiolles had a longer elbow, which was set at an angle of 130 degrees with the shaft.

The double-elbowed (*bi-coudé*) catheter as its name implies, is, one where the terminal portion has a second angle about thirty-eight mm. back of the first. It is made of the same material as that with the single elbow, but the second angle is not so abrupt as the first. Where

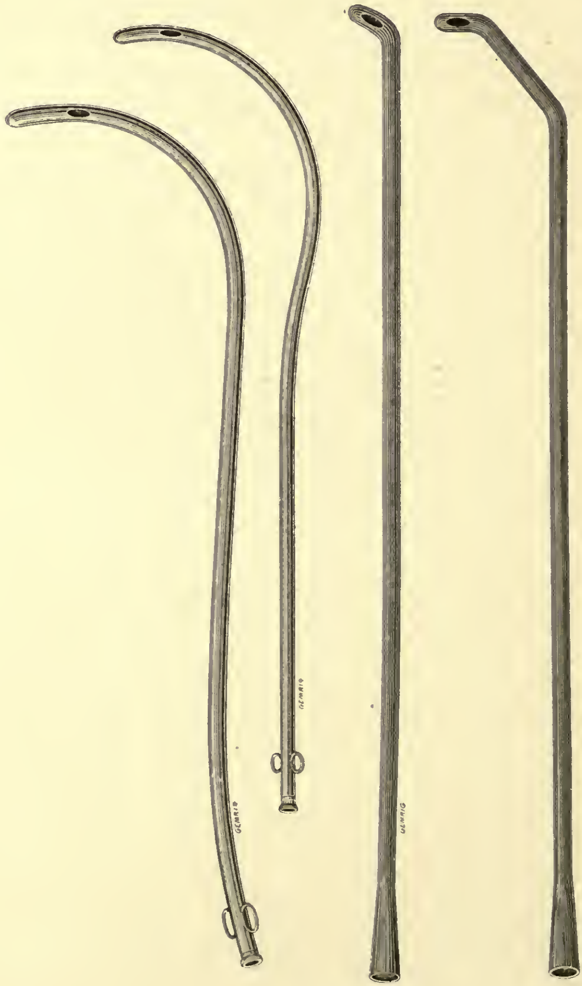

FIG. 60.—1, 2. Metallic catheters with prostatic curves. 3. Mercier's elbowed, or *coudé* catheter. 4. Double elbowed, or *bi-coudé* catheter. (Half natural size.)

the tip of the single-elbowed catheter is hollow it may be passed with a stylet of similar form, when by partially withdrawing the stylet a second elbow will be produced at any desired situation (Guyon). There is little risk of the stylet protruding at the eye in its passage, as will be seen by practising these maneuvers before introducing the catheter.

All catheters made of webbing should have the eye woven in the making; to have it cut subsequently leaves a sharp and oftentimes ragged or ravelling edge.

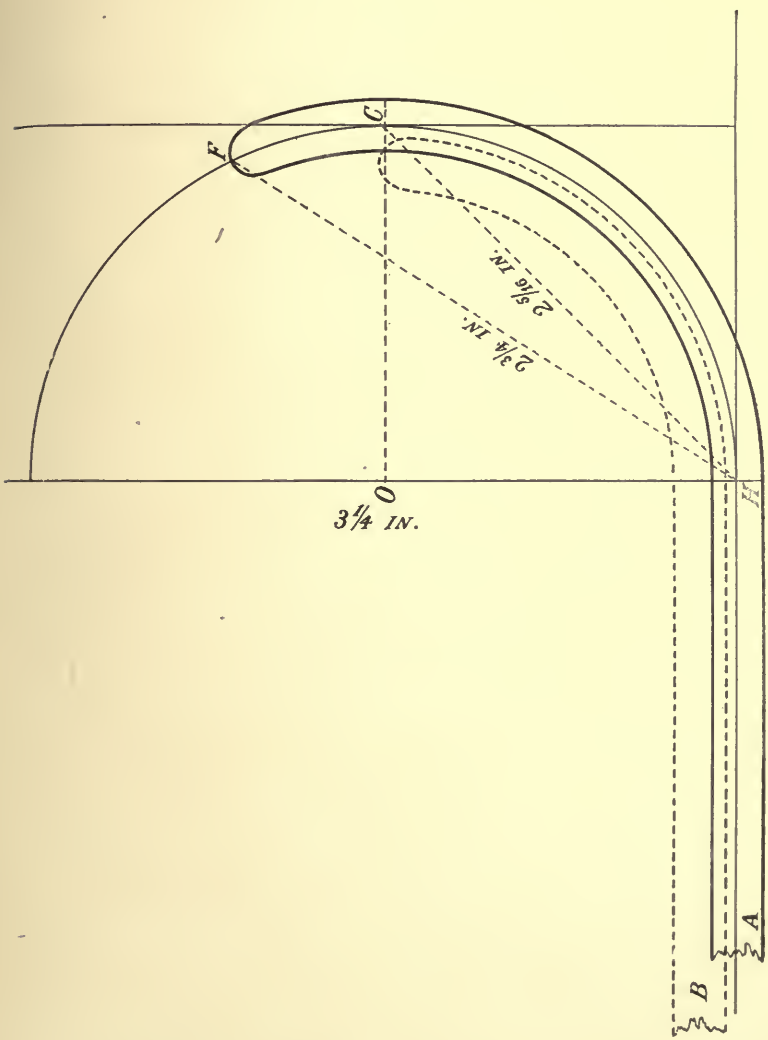

Fig. 61.—Diagram of the Proper Curves for the Ordinary and the Prostatic Catheter. *O H.* Radius of circle whose diameter is 90 mm. (3½ inches). *H C.* Curve of ordinay catheter, subtended by a chord of 55 mm. (2 5/16 inches). *H C F.* Curve of prostatic catheter subtended by a chord of 70 mm. (2¾ inches).—(*After Van Buren and Keyes.*) (Larger than natural size.)

It is convenient in these, as well as in curved metallic urethral instruments, to have some indicator on the handle to show which way the beak is pointing. So far as we know, there is at present no better way provided of determining this point, in the case of the Mercier catheter, than by recollecting the relation to the beak borne by the printing on

the shaft. With the English catheter a similar precaution may be employed, except when it is used with the stylet, when the ring-like extremity of this guide will indicate the direction of the curve.

Metallic catheters usually have a curved beak. The original Mercier catheter was silver, but, as already mentioned, it is now usually made of webbing. The normal curve of the subpubic urethra is that of the circumference of a circle whose diameter is 90 mm.; and the length of curve is the arc subtended by a chord of 70 mm. but the curve of the catheter is usually subtended by a chord of only 55 mm. (Van Buren and Keyes.)

In the urethra altered by prostatic enlargement, however, the curve is considerably increased, having both a greater diameter and a greater length of arc; so that various metallic catheters with "prostatic curves" are found on the market. Probably the largest required curve is one which is one-third of a circle whose diameter is twelve and a half cm. It is important not only to have the curve thus larger, but for the curve to be greater at the tip than elsewhere, thus approaching the instrument of Mercier in type. At the very least, the curve should be continued to the very end of the catheter.

The tip of metallic catheters should be solid, to allow no nidus of infection to exist, and it is even more indispensable here than in the case of the webbed catheters for the eye to be made in the mould, and not to be subsequently cut out by a punch. The shaft should be at least twenty cm. in length beyond the beginning of the curved beak, since with an instrument of customary length the bladder might not be reached.

Metallic catheters should be plated with nickel, silver, or some other non-corrodible metal; and should be provided with two eyelets at the handle, to serve as indicators of the direction in which the beak is pointing. Or the catheter may be S-shaped, the opposite direction of the two curves effectually indicating the position of the beak.

In all these catheters for use in prostatics the eye should be amply large, and should be placed in the concavity of the curve; or one eye may be placed on each side, at different levels, but from ten to twenty-five mm. from the end. It is also best to use an instrument of as large a calibre as the urethra will conveniently take, since there is thus less danger of entering or of producing false passages, and a better chance exists of evacuating pus or blood clots from the bladder.

(b) Sterilization of Catheters.—Soft-rubber catheters may be boiled. If they are stewed, the elasticity and tone is lost very soon; but if the water is brought to the boiling point before the catheter

is placed in it, the rubber will stand repeated boilings of from three to five minutes without showing material degeneration. Where boiling cannot be employed, as is the case under some circumstances with rubber catheters, and with all catheters made of webbing and coated with shellac, chemical disinfection must be used. Carbolic acid, in the strength of one part to twenty of water, has been much relied upon, the catheters soaking in such a solution for twenty or thirty minutes. This substance has the disadvantage, however, of rendering the catheters so flimsy, even when the solution is cold, as to make them very difficult to use; so that latterly we prefer a 10 per cent. solution of formalin, which is itself a 40 per cent. solution of formaldehyde gas in water. The well-known hardening effect of formalin preserves the desired form of these catheters admirably. Some surgeons have found the use of formalin so irritating to the mucous membrane of the urethra as to cause great pain to the patient. as well as at times to produce a rather severe urethritis. We have not however, seen any such effects. Wolff advises the use of a one per cent. solution of corrosive sublimate in equal parts of glycerine and water, the catheters being germ-free at the end of six hours. This solution is claimed to possess the threefold merit of sterilizing the catheters, preserving their elasticity, and rendering them ready for instant use without the intervention of any other lubricant.

Metallic catheters are readily sterilized by boiling. The practice of merely igniting alcohol which adheres to their surface is by no means sure as a disinfectant, unless the catheter is already of more than ordinary cleanliness. Where catheters are religiously cleaned and boiled after each time they are used, this method will serve very well as a rapid and efficient manner of sterilization; but if the catheter has been put away with septic blood clots or inspissated pus in its interior, it is idle to expect the momentary application of a flame to its surface to render infection impossible.

All catheters should be subjected to the ordinary rules of surgical cleanliness immediately after being used. After being washed clean in soap and hot water, and their cavities thoroughly syringed out, and emptied if need be of clots, etc., by means of absorbent cotton mounted on a stylet, they should be returned to the antiseptic solution; or if there will be no need for their use soon again, they may be wrapped in a sterile towel, after being shaken dry in the air.

Rubber preserves its elasticity better when kept wet, and it should never be laid away in a dry warm place.

Various types of formalin vapor sterilizers may be purchased from the instrument makers, but personally we have but little faith in the ability of formalin vapor to sterilize instruments, and much prefer to immerse them in a solution of formalin or of carbolic acid.

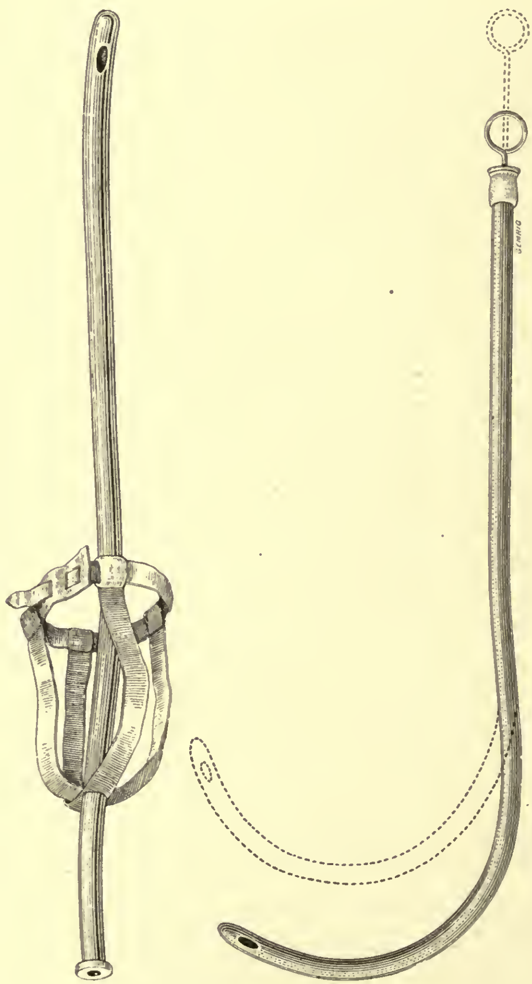

Fig. 62.—Catheter with Bridle Attached, to Facilitate its Retention in the Bladder. 2 English Catheter on Overcurved Stylet. The Dotted Lines Show the Curve Increased by Partially Withstanding the Stylet.

This applies only to such instruments as will not stand boiling. In fact, if certain precautions are taken, the best grade of modern French woven catheters may be boiled without damage to them. These instruments are coated with varnish which softens when they are boiled but becomes hard again when the instrument is immersed in cold water.

Nothing must be permitted to touch the instrument when it is heated and it must lie perfectly straight in the sterilizer and no part of it should come into contact with any other object. Bending or grasping the heated catheter with a pair of forceps usually mean the end of usefulness of that catheter.

Where the patient has to catheterize himself, and must care for his catheters in person, it is expedient to render his necessary manipulations as simple as possible. Moullin recommends that he keep in his wardrobe, or wherever else may be most convenient,

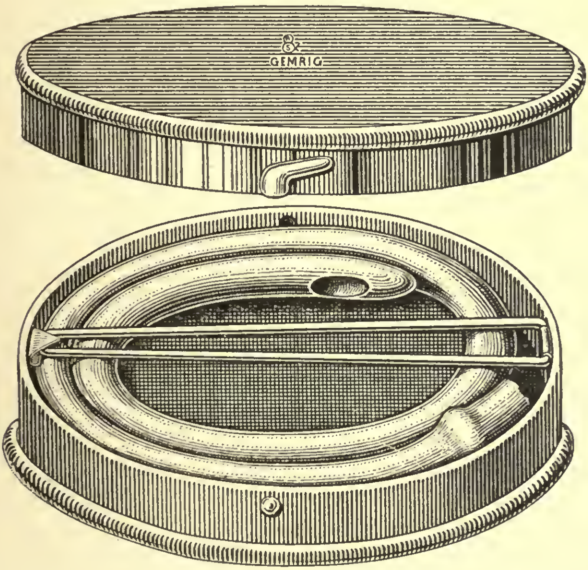

Fig. 63.—Aseptic Pocket-case for Catheter. Natural Size.

two glass cases, long enough to contain the catheters without bending them; one case should hold a small piece of absorbent cotton moistened with formalin, and the other should be filled with boric acid solution, which should be changed every day. A douche bag filled with a strong solution of green soap should also be provided. The catheters, which should at least equal in number the number of times during twenty-four hours that the patient must catheterize himself, and which are of course flexible or semiflexible, should be rinsed through thoroughly with the soap solution and hot water immediately after use, and then be placed in the boric acid solution. Once each day, or oftener, all the catheters should be boiled, and then stored in the formalin case

until ready for use. It appears to us that this is rather a complicated process of sterilization for the average prostatic; and we would at any rate suggest that after use and cleansing with the soap and water, the catheter should be placed in the formalin jar, and remain there for six hours at the least. It may then be transferred to the boric acid solution for some time before use, and thus will have been sterilized by the formalin, and will have had the irritating qualities of this antiseptic removed, before being brought into contact with the urethra. By this plan also the necessity of boiling is avoided, and however useful this may be for metallic and india-rubber instruments, we cannot but think it destructive to those constructed of webbing and covered with shellac when oft-repeated sterilization by an inexperienced individual is necessary.

English catheters should be kept mounted on a stylet of proper curve, and be immersed in the antiseptic solution (formalin or carbolic acid) for a half-hour before they are used; they should then be thoroughly cleansed and dried. Freyer is quite content if he can accustom his patients to the conscientious use of soap and hot water. The hands, foreskin, glans penis, and the urethra of the patient should be suitably prepared for catheterization, as directed elsewhere.

When the patient travels, he must be able to carry his catheter with him in an aseptic and yet not too bulky a form. For this purpose various pocket cases are found in the shops, of which the best are made of metal, so that some formalinized cotton can be kept in them along with the catheter, which is coiled up so as to occupy less space. An ordinary metallic soap-box may be used.

(c) **Lubricant.**—For many years olive or castor oil has been employed as a lubricant for catheters. These substances may be sterilized by boiling, but unfortunately they do not remain sterile very long; and the addition of strong antiseptics is very apt to roughen the surface of webbed instruments in time, or else is ineffectual in sterilizing the oil. Yet we are quite satisfied to use carbolized olive oil of the strength of one to twenty. Senn recommended "sterilized vaseline, with the addition of $2\frac{1}{2}$ per cent. carbolic acid or 1 per cent. of formic aldehyd." Burckhardt prefers a one per cent. solution of salicylic acid in sterilized olive oil; while, as already mentioned, Wolff lubricates and at the same time sterilizes his catheters in a one per cent. sublimated solution of glycerine and water. An aqueous solution of boroglycerine is another useful lubricant. The preparations on the market consist of Iceland moss in various combinations containing formalin, carbolic acid, oxycyanid of mercury or other antiseptic.

Dr. E. Wood Ruggles has offered the following formula which is essentially the same and quite as good as the best lubricants sold under trade names.

Dissolve 1 cm. of oxycyanid of mercury in 200 cc. of hot sterile water; add 35 cc. of glycerine and water enough to make 350 cc. After this mixture has cooled add 10–15 gm. of gum tragacanth. After standing for several days the lubricant is ready for use.

When the patient catheterizes himself, it is far safer as well as more convenient for him to be provided with numerous flasks or sterile collapsible paint tubes each containing ten cubic centimetres of the lubricant, which he then squeezes directly into the urethra, thus minimizing the risk of infection.

(d) Method of Passing Catheter.—The choice of catheters should always be for the soft-rubber first, then for the Mercier, then the English, and finally, in rare instances, the metallic instrument. There is probably no department of surgery in which practice, habit, natural aptitude, a light hand, good temper, and patience, are of such paramount importance as in catheterization. It will seem to the patient as if one surgeon rushed at him from the other end of the room with a crowbar in his hand, prepared to plunge it into the unfortunate man's urethra, while another surgeon will gain entrance to the bladder before the patient has really become aware of his maneuvres. And it is next to impossible to incuicate by precept the many tricks which may be required to insinuate a rebellious catheter into an obstructed urethra; only by example and long-continued practice may the uninitiated learn these matters.

It is always good to have clean hands, and should be a characteristic of the surgeon; but where a flexible catheter is to be passed ordinary cleanliness will not suffice. As it is necessary always to hold such an instrument close to its point of entrance into the urethra, and as therefore it must be fingered throughout its whole length during its introduction, the surgeon's hands should be sterilized as for a serious operation before he presumes to touch the sterile catheter.

The glans penis and the foreskin of the patient should be washed with soap and water, the fatty substances then removed with 70 per cent. alcohol, and finally the glans should be rinsed with corrosive sublimate solution (1 to 1000); the anterior urethra should next be flushed out, first, if possible, by directing the patient to pass what urine he is able to, and then by an injection of boric acid solution (2 per cent.). The catheter then being taken in hand, should be thoroughly

lubricated by being dipped in a sufficient quantity of the lubricant, which is then allowed to run up its whole length; or an injection of the lubricating fluid may be made directly into the urethra. The end of the catheter is then to be carefully inserted into the meatus. We may say here that where there is a prospect of oft-repeated and long-contined use of the catheter, we think it wisest to do a meatotomy at once, when the meatus is not amply large.

The Nélaton catheter is so flexible that it must, as already mentioned, be held close to the penis, and urged forward 25 mm. or less

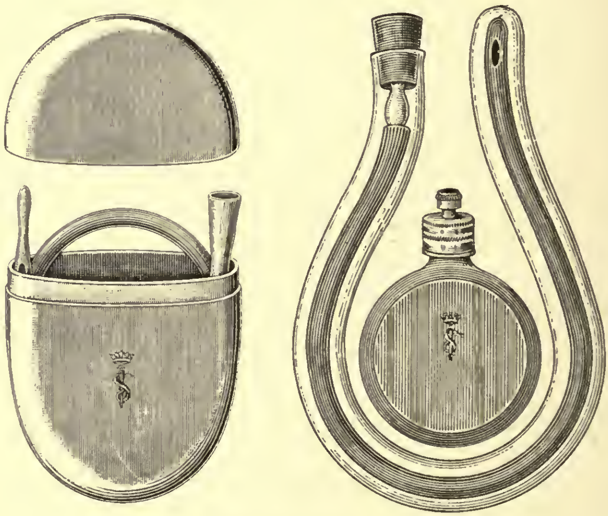

Fig. 64.—Aseptic Cases for Catheters.
The U-shaped tube has a special flask for the lubricating fluid.

at a time. In fact, the urethra should seem rather to swallow the catheter than that the latter was being forced in. It is well to know just how long the catheter is, so that the amount already introduced may be readily gauged from the portion which still remains within the hands. If when the tip of the catheter has reached the prostatic urethra it will not readily pass onwards, the finger should trace its course through the perineum and from within the anus, and an attempt should be made to direct it on into the bladder. If the catheter feels firmly imbedded, it should be partly withdrawn, and then again passed forward with a quicker and somewhat rotatory motion, as its tip may have been engaged in a false passage or entangled in a fold of mucous membrane. At the same time, with the finger in the rectum the catheter's point should be kept against the upper wall of the urethra, out of the usual

neighborhood of false passages and obstructions. If, finally, no reasonable endeavors will succeed in introducing the soft-rubber catheter into the bladder, this instrument should be withdrawn, and a Mercier elbowed catheter passed. The manner in which this catheter is to be handled does not differ materially from that just described; but it should be the surgeon's care that the elbowed beak follows the roof of the urethra, as it will thus be more likely to glide over the raised internal orifice of this canal.

The Mercier catheter also failing, the surgeon should next attempt the English catheter, moulding it to a proper curve before introducing it into the urethra. If it will not pass without the stylet, it should be withdrawn, and then re-introduced with the stylet in place. When the obstruction previously encountered is again met, if slight persistence in pressing the handle well down between the patient's thighs will not cause the beak of the catheter to surmount the obstruction, the surgeon may by withdrawing the stylet about twelve mm. raise the beak a sufficient distance to enable it to ride over the prominence of the prostate. It is very rarely necessary to employ silver catheters in recent cases—that is to say, in cases where the urethra has not been much tampered with by other instruments. Occasionally, however, where there has been long-standing inflammation of the parts about the prostate and the vesical neck, the tissues are so hard and resistant that although no real mechanical obstruction may exist to the passage of a catheter, yet the flexible and semiflexible instruments are not strong enough to press apart the sclerosed structures. In such cases, the use of a metallic catheter may be indispensable; but in employing one it should be constantly borne in mind that even the very minute amount of force that is justifiable here will do an incalculable amount of damage unless the channel of the urethra is strictly adhered to. Hence the surgeon should make it a golden rule to cling close to the roof of the urethra, and never for an instant to use any degree of force, however slight, out of the median line. He will be far more apt to succeed in the object he has in view if he keeps cool and avoids metal instruments.

If the first examination of the patient has been conducted in the manner advised in Chapter VII, much valuable information will have been acquired as to the character of the urethra and its obstructions, so that at a later date catheters can be passed with a fair amount of intelligence and certainty.

The patient should use the catheter which is most easily passed;

but he should never be allowed a metallic instrument. The soft-rubber catheter is the most harmless, but so great seems to us the danger of infection from the necessity of handling it so extensively during its introduction—an objection which applies also, though in less degree, to the Mercier catheter—that we have a strong preference for the English catheter for the patient's use. These catheters are so firm as to be readily introduced by holding their outer end only, as with the metallic catheter, and are at the same time sufficiently flexible to render them safe even in not very skillful hands. Under these circumstances they should, of course, be passed without the stylet.

The frequency with which a prostatic should be catheterized depends *entirely* upon the distress occasioned by the residual urine, *provided* always that the latter is not increasing in quantity. As a rule, however, it will be found that when a patient has as much as 120 cc. of residual urine he will be so regularly disturbed at night as to require the complete evacuation of his bladder by catheterization once in the twenty-four hours. The most suitable time for this evacuation is just before retiring for the night. It is the least inconvenient time possible for the careful attention to personal and instrumental preparation, and is also a time when the emptying of the bladder will be apt to give the longest relief for the ensuing night.

Many a patient, nevertheless, who has this amount or even more of residual urine will not be sufficiently inconvenienced by it to necessitate regular catheterization at all. The surgeon should not, on the other hand, dismiss such a patient from his care, but should attentively watch him, and by passing a catheter every three or four months ascertain whether the residual urine is increasing. It is in just such quiescent cases as these that the residual urine accumulates, increment by increment, until atony of the bladder is well advanced, and overflow from retention occurs; or absolute retention with complete dependence on the catheter makes the remaining days of the patient one long drama of misery.

If the residual urine, therefore, is found in the course of weeks or months to be steadily increasing in quantity, the surgeon should not hesitate, even though no compelling symptoms exist, to resort at once to habitual catheterization, as the only preventive of vesical atony.

Under either of these circumstances then—the presence of symptoms, or the steady increase in residual urine without symptoms—the catheter should be used once in the twenty-four hours for 120 cc. or less of residual urine. If 180 cc. are present, use it twice, night and morning;

and add one more catheterization for each additional 60 cc. of urine up to six times daily. When the required number of catheterizations exceeds this limit, some other form of treatment is urgently demanded, even though catheterism appears to maintain the patient's normal health.

3. **Prevention of Complications.**—The most serious complications which it is our duty to endeavor to prevent are cystitis, retention of urine in all its varieties, calculus, Bright's disease, and uremia.

Cystitis.—The causes of cystitis in cases of enlargement of the prostate being almost exclusively infection from without through instrumentation, the paramount importance of aseptic habits in this particular is readily recognized. All that was said as to the means of sterilizing urethral instruments, the manner of introducing them, and the state of the surgeon's hands and of the patient's urethra, glans penis, and foreskin, should be borne in mind; as far as possible all instrumentation should be avoided; and, moreover, the diet and drugs habitually advised should be such as to prevent vesical congestion or irritability. The state of the urine should be closely watched, and over-acidity or alkalinity strenuously combated. If strictures exist, the prevention of cystitis is even more important, as the bladder will have been in a state of less resistance for some time. Hence the strictures should be systematically dilated, the benefits derived from this treatment when carefully conducted far outweighing the dangers of infection. The passage of large-sized steel sounds through the prostatic urethra also will tend to prevent progressive obstruction from the diseased organ, in accordance with the teachings of Reginald Harrison; and by thus maintaining an open channel for the urine, may postpone if not entirely prevent the development of cystitis.

Although the prevention of cystitis is so important a part of treatment, it is a sad fact that the treatment of fully developed cystitis constitutes the greatest part of the surgeon's labor in these cases; and this is perhaps so because an uninflamed bladder rarely gives rise to feelings of discomfort on the patient's part or of anxiety on the part of his attendant. But some patients are so subject to urinary fever, that although they may recover from an attack, yet, this complication being ever present in the minds of both surgeon and patient, extraordinary methods are necessary to avoid its recurrence. In these patients more than any others should instrumentation be as limited as possible, and when necessary the most "pedantic precautions" (Senn) against infection should be observed. Quinine or opium, or both, should be adminis-

tered some hours before the catheter is used, and should be repeated at intervals of three or four hours afterwards until all danger of chills and other infective manifestations has passed. As it is probable that both urethral and urinary fevers are occasionally due to the septic condition of the urine itself, and not to any new infection carried in by the instrument, it is well also to give these patients a course of urinary antiseptics, such as salol, urotropin, sodium benzoate, etc. Since, moreover, these manifestations of infection are predisposed to by interstitial nephritis, every effort should be made from the beginning of treatment to get the kidneys into good working order and to keep them so.

Retention of Urine.—There are several varieties of retention of urine, which it will be convenient to define at the outset, that we may know the conditions indicated by each term: (1) Acute Complete Retention: where the patient, who was before able to evacuate his urine wholly or in part, becomes unable to do so—all the urine is retained, and the condition is acute. (2) Chronic Complete Retention, where the patient depends absolutely upon the catheter as a means of emptying his bladder, being unable, quite as much as in the first variety of retention, to expel a single drop of his own accord—all his urine is retained, but the condition is chronic. (3) Chronic Incomplete Retention without Distention of the Bladder, where a certain portion of urine is constantly retained, but where the major portion is evacuated voluntarily—a chronic condition, where, without the bladder being overfilled, residual urine exists. (4) Chronic Incomplete Retention with Distention of the Bladder, where so much of the urine is retained that the bladder has reached the limit of its capacity, and overflow from retention results.

Guyon mentions still another variety of retention, which he terms acute incomplete retention, and says it is very rare. We ourselves have not observed such a condition, and as M. Guyon leaves its symptoms somewhat to the imagination, we are unable to describe it more fully than by giving its title.

Acute Retention.—

1. Acute Complete Retention.

Chronic Retention.—

2. Chronic Complete Retention.
3. Chronic Incomplete Retention without Distention. (Residual Urine.)
4. Chronic Incomplete Retention with Distention. (Retention with Overflow.)

The first variety may attack either a patient with no residual urine,

or one in whom the urine has been partly retained for some time. In either case it is almost invariably due to a sudden increase of congestion in the prostatic urethra and the vesical neck. Hence for its prevention all those things should be avoided which have already been mentioned as favoring this state of affairs: Exposure, chilling of the skin, wet feet; retaining the urine an undue time; eating or drinking too freely; lying too long abed.

The second variety, chronic complete retention, is almost invariably the result of absolute atony of the bladder. It arises probably most frequently as a consequence of the third variety, where the residual urine slowly accumulating ultimately entirely overcomes the power of the bladder to contract and expel any portion of its contents. In some instances it is due to mechanical obstruction from the growing prostate, which prevents, even if the tone of the bladder is preserved, any urine from being expelled. In exceptional cases retention of this kind succeeds immediately upon acute retention, the bladder being then so very much distended that it never regains its contractility. This complication hence is to be prevented by regularly evacuating the residual urine by catheterization, and at times by moulding the prostate as it grows, so as to keep an open water-way from the bladder; also by preventing acute retention.

The third variety, that where a varying amount of residual urine is present, is the nearly universal state of prostatics, and is practically unpreventable. In the early stages of enlargement, if no residual urine exists, absence of symptoms is usual, and instrumentation in an attempt to hinder the growth of the prostate by pressure will be more likely to cause cystitis or prostatitis than to prevent the development of a post-prostatic pouch.

The fourth variety, retention with overflow, succeeds upon the third when a very small amount of contractile force is still preserved in the bladder, and when the urethra is not absolutely obstructed by the prostatic growth. It rarely occurs where cystitis is present; and is best prevented by regular aseptic catheterization during the earlier stages of the disease.

Atony of the Bladder.—Atony of the bladder, it is thus seen, is an even more dreaded accompaniment of prostatic obstruction then retention of urine, of whatever variety; for where atony is extreme, it cannot be remedied even by restoration of the urethra and vesical neck to their normal condition. Even though the whole obstructing prostate be removed successfully, and an easy entrance to the bladder be gained

by catheters, yet the power of contractility lost from prolonged overdistention will in some few cases never be regaineb. Fortunately, however, prognosis is no longer so gloomy as it was only a few years ago. We have learned through the brilliant successes of Freyer and other surgeons that in some instances where for fifteen or twenty years the patients had depended absolutely on the catheter for the evacuation of every drop of urine—the complete removal of the enlarged prostate has within a few months or even weeks brought back contractility and good expulsive power to bladders that were thought before operation to be hoplessly diseased. And although, as we say, we can no longer regard atony which is apparently complete as entirely irremediable, we should nevertheless spare no pains to prevent its development. To this end the bladder should never be allowed to become distended. Where the catheter is employed habitually, great pains should be taken to ensure its entrance into the bladder with the evacuation of all the residual urine, not merely drawing off the small amount that may exist in the dilated prostatic urethra, and leaving the true residual urine to accumulate until either complete chronic retention or retention with overflow has developed. And where the catheter is not habitually employed, nothing should prevent regular periodical examinations to determine the question whether the residual urine is increasing or not.

Calculus.—The prevention of the formation of calculi in the bladder applies not alone to those means usually employed in patients where no prostatic enlargement exists; for in prostatics we have constantly present a stagnant pool of urine in the bladder, ready at any moment of neglect to crystallize around a blood clot or a plug of mucus or pus. The customary dietetic treatment must be employed; the urine should be carefully watched, and maintained in a dilute and non-irritating condition; and the residual urine should be systematically evacuated. In patients with a family history of calculus, or with a lithemic tendency, the rule of non-interference with quiescent bladders where the amount of residual urine is not increasing, must be abandoned; and on any occurrence of bladder irritability a stone should be carefully searched for.

Hemorrhage into the Bladder.—This is a complication of extreme gravity. If cystitis does not already exist, infection is practically sure to arise as soon as any amount of blood accumulates in the bladder. Hemorrhage may occur spontaneously, but is usually due to rough or careless instrumentation. The site of the bleeding is frequently the prostatic urethra, whose upper wall may be lined with distended vari-

cose veins; but it most often arises from a point on the prostate which is habitually abraded by the introduction of a catheter. Occasionally it follows upon the complete sudden evacuation of a distended bladder from the relief of intravesical pressure, being then in the nature of a general ooze from the mucous membrane. Calculous concretions are at times the exciting cause. In any case, the surest method of prevention is the continued use of the utmost gentleness in all manipulations. There is little doubt but that some cases exist where even the most skillful and gentle surgeon cannot avoid provoking bleeding; but far more often it is directly due to culpable negligence or ignorance on the part of the person who attempts catheterization. The use of flexible or semi-flexible instruments is, as often before insisted upon, infinitely less harmful; and with their use hemorrhage from traumatism is least likely to occur; in rare cases, however, its recurrence is most readily obviated by recourse to a metal catheter of large calibre and of an eminently fit curve—one that has been proved on previous occasions to enter with facility the bladder of this particular patient. The habit of employing metal catheters is, however, a pernicious one, and only a surgeon with the greatest patience, the deftest and lightest hand, should feel himself qualified to introduce one in cases such as this.

As mentioned above, hematuria at times supervenes upon the sudden complete withdrawal of intravesical pressure; so that this is a reason against the indiscriminate emptying of chronically distended bladders, in addition to the danger of syncope and renal complications.

Orchitis.—Orchitis is a complication to which some patients seem peculiarly liable, attacks recurring again and again, oftentimes from no apparent cause. Usually, however, the affection may be traced to infection from instrumentation, and is hence best prevented by limiting instrumentation as much as may be, or by avoiding it altogether, should this be practicable. Vesical and prostatic congestions should also be avoided by the methods already indicated on previous pages.

Renal Complications and Uremia.—Finally, nephritis, surgical kidneys, and uremia must be prevented if possible from becoming complications of this already sufficiently troublesome disease.

Carefully selected food, plenty of fluid, and good bladder drainage are the most important means by which renal complications may be avoided. Increase of renal pressure from damming up of the urine is one of the most unfailing causes of renal insufficiency; and is, of course; best prevented by securing a free outlet of urine from the bladder. For this purpose catheterization will usually suffice; but when kidney

breakdown is threatened from backward pressure which cannot be otherwise satisfactorily overcome, we think there can be no doubt that permanent drainage of the bladder is indicated. If feasible, this should be procured through a permanently retained catheter; but should such a course not be possible, or should it have failed to avert the impending disaster, no hesitancy should be entertained about opening the bladder suprapubically, and thus establishing an artificial urethra which will at once relieve the kidneys of injurious pressure. The choice between the two operations—suprapubic or perineal—will be considered when discussing the treatment of complications.

By thus relieving the backward pressure on the kidneys, and by preventing the development of cystitis, the renal condition of these patients will be kept as nearly normal as possible; and when this is the case, little fear need be entertained of their being overwhelmed by uremic symptoms; but it is only by the strictest attention to the state of the urine on the one hand, and to that of the circulation on the other, that the kidneys can be maintained in suitable condition.

4. Treatment of Complications. Cystitis.—Cystitis is treated both locally and constitutionally. The local treatment may be considered under three headings: first, that by means of drugs acting through the kidneys; second, by means of irrigations and of injections into the bladder; and third, by means of drainage of the bladder.

In no cases of cystitis should the constitutional treatment be neglected. If the inflammation is acute, and extremely painful, rest in bed should be enjoined. The diet should be liquid or at most semi-solid. Plenty of water should be taken. Hot sitz-baths may prove beneficial, once or oftener in the course of twenty-four hours. The bowels should be well opened by mild cathartics or an enema.

In mild cases these means alone may suffice to effect a cure, within one or two days. Where the pain is severe and incessant, an opiate may be required; if morphine is contra-indicated by the state of the kidneys, or other affection, some milder hypnotic and analgesic may be used. The bromides and chloral in combination often act well; hyoscine, chloretone, sulphonal, trional, or even paraldehyde, valerian, or asafœtida, may act benefically.

The condition of the urine is an all-important guide to further medicinal treatment. Acid urine, as previously mentioned, is best neutralized by reducing the amount of sugar ingested, diluting the urine by an increase in the quantity of fluid taken, and by certain of the alkaline waters. Where the urine is alkaline we may resort to the usual

remedies, such as boric or benzoic acid, sodium benzoate, urotropin, etc. As an exceptionally useful urinary antiseptic we recommend salol.

The aseptic and regular employment of the catheter, to remove any residual urine, is frequently enough in itself to restore the bladder to its normal state.

Combined with remedies such as the above, where the alkalinity of the urine is not readily overcome, or where there is much pus or blood present, the bladder should be washed out. As a rule, the best solution is the decinormal solution of sodium chloride, which may readily be improvised by adding a teaspoonful of common table salt to a half a litre of sterile water. The proper solution consists of sodium chloride, six gm. sodium bicarbonate, one gm. and sterile water, one litre. The use of drugs in the irrigation fluid is very rarely required; but boric acid solution one half to one gm. to each thirty cc. may at times clear up the urine sooner than the plain salt solution. Silver nitrate should never be employed except in cases of chronic cystitis; it may be commenced in the strength of 15 mgr. to each 30 cc. and if well borne, and if it appears that anything may be gained by such a course, the strength may run up to one third to two third gr. for each 30 cc. Great care should then be exercised that no part of so strong a solution comes into contact with the urethra, which would probably be much irritated by it; but when acting on the transitional epithelium of a bladder whose walls are further protected by thick layers of mucus, and perhaps incrusted with salts, it does not seem probable that any harm can arise. Potassium permanganate, in the strength of 1 to 4,000 is at times a useful drug.

The temperature of any solution employed should be between 90° and 100° F.; and it should not negligently be permitted to cool unduly during the process of irrigation. The position of the patient should usually be supine; but where the post-prostatic pouch is large and difficult to drain, the pelvis may advantageously be raised six or eight inches.

The manner in which the bladder irrigations are given is important. It is very much better and more comfortable to the patient for them to be given through a soft-rubber or even a Mercier or English catheter; but where these cannot be introduced into the bladder, a metal catheter may readily be utilized by attaching a rubber tube to its outer extremity. Two methods of injection are used: the first by means of a syringe, holding at most 30 cc., whose tip is carefully placed in the outer end of the catheter, which should be funnel-shaped for its reception; the other method consists in attaching by means of glass and

rubber tubing, a small funnel, holding about 30 cc. of water, into which the solution is poured, and from which it is allowed to run into the bladder by the force of gravity. Where a syringe is used for the injection no force whatever should be used in pushing the piston home; indeed, it will usually be found that when the syringe is held vertically the piston sinks upon the contained fluid by its own weight. When the tubing and funnel apparatus is employed (and it is the more convenient when available), the funnel should never be raised to a height of more than two feet above the patient's bladder; usually the fluid will run easily at a height of a few inches. Whichever apparatus is used, not more than 120 cc. at the outside should be thrown into the bladder at any one time; when this quantity, or less if pain be caused, has been injected, it should be allowed to remain for ten or fifteen seconds, and then let out; nor should the abdomen of the patient be kneaded too vigorously in an effort to hurry the process. It is a form of treatment that requires patience and time, and nothing is to be gained by haste. The bladder should not be refilled more than four or five times at the same sitting, and the operation should not be repeated, except in offensive cases, oftener than once in twenty-four hours.

Contrary to the general rule above stated: to the effect that not more than 120 cc. of fluid should be injected into the bladder at once,—which rule, however, we invariably adopt at the first irrigation,—we believe that much good may accrue from the passive but very gradual distention of chronically inflamed and contracted bladders. Thus we have seen patients who at the first sitting could not bear to have more than 30 cc. thrown into their bladder at one time, in the course of a few weeks, regain lost bladder capacity so that instead of 30 cc., three or four finally six or eight times the amount could readily be retained; the patient meanwhile experiencing a corresponding decrease in the frequency of urination. But the most gradual distention in the world should be practised: we are quite satisfied if we can establish a tolerance for a few cc. additional at each sitting.

In the practice of irrigating the bladder the attendant, and the patient as well, will often lose heart from the apparent slowness of progress in the relief of the cystitis; and many a time the surgeon will feel tempted to throw a large quantity of fluid into the bladder rapidly and with considerable force, in the effort to clear its cavity of accumulating mucus and blood clots by a process analogous to hydraulic mining; but let him beware that he does not adopt such a practice! The sudden changes in form to which such methods would subject the bladder would

but augment the inflammation, and might possibly cause the rupture of some of the vessels in its walls, burst some thin-walled sacculi, or carry infection into the ureters and on the way to the kidneys. The bladder itself might even be ruptured. It should be remembered that there is no expectation of mechanically ridding the bladder of the products of inflammation and hemorrhages; we are not even operating by a variety of litholapaxy; and however pleased we may be when a quantity of débris is spontaneously evacuated through the catheter, we must not forget that our object is rather to prevent the persistence or extension of the inflammation than to remove its products—we hope that these may dissolve and be passed by the urethra in the natural course of events.

But in some cases these means do not suffice to arrest the cystitis; the introduction of a catheter is painful, difficult, or even impossible; the bladder irrigations give no relief; renal and uremic complications impend, and urinary fever has already set in. Under these circumstances no further delay should be tolerated, but as soon as it is evident that ground is being lost the bladder should be drained.

Of course, the simplest way by which this may be accomplished is by permanently retaining a catheter, so that its eye projects just within the vesical cavity, and the urine is collected and discharged drop by drop, just as it is received from the ureters. It is important to have the catheter neither too far in, nor yet too far out of the bladder: in the former case its tip will cause great irritation of the vesical trigone, while in the latter the drainage will be very imperfect. To ensure its being in the correct situation, the catheter should first be fully introduced into the bladder until the urine flows in a steady stream; then it is to be slowly withdrawn until the urine stops running entirely, which it does when the eye enters the urethra; and then, finally, the catheter is to be pushed back again about ten to twelve mm. until the urine escapes through it by drops.

But it is an exceedingly difficult matter to keep a catheter permanently in the correct place. Many forms of self-retaining catheters have been invented, but in our opinion there is not one of them which is practically useful. The Nélaton catheter should, if possible, be that selected for the purpose, as being perfectly flexible it is less apt to cause irritation. Some degree of urethritis is nearly unavoidable, but with in flexible instruments not only is urethritis more likely but every change inposition of the patient is liable to wound the prostate, or the bladder; besides which it is very difficult to secure such a catheter in place.

For rubber catheters the appliance shown in Figs. 65 and 66 may be used, when it is at hand. This consists of a caoutchouc bridle attached at one end to the catheter at its point of entrance into the urethra, and fastening at the other around the body of the patient's penis. Where this is not available the catheter should be transfixed with a double ligature, through the loops of which, tied fairly close to the catheter on each side, strips of adhesive plaster are to be adjusted and fastened in a spiral

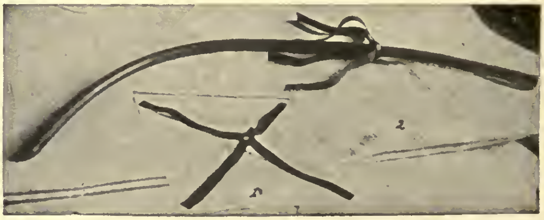

FIG. 65.—CATHETER RETAINER. (CAPLES) *Surgery, Gynecology and Obstetrics.*

and interlacing manner around the body of the penis. If a ligature cannot be procured in an emergency, the catheter may be transfixed with a safety-pin, and the adhesive plaster tied to that. Care should be

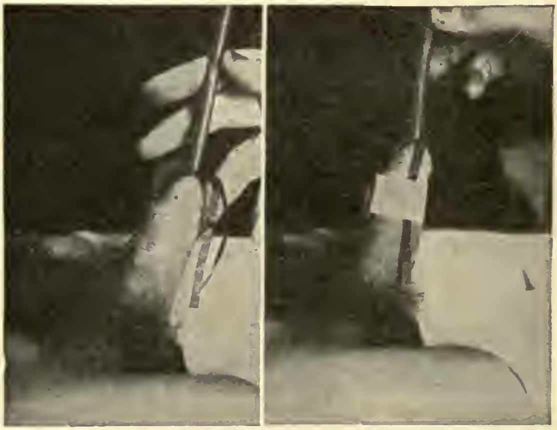

FIG. 66.—CATHETER RETAINER. (CAPLES) *Surgery, Gynecology and Obstetrics.*

taken that the attachment of the plaster to the catheter, in any case, is close to its point of entrance into the urethra, thus preventing the catheter from slipping too far in, as well as keeping it from falling out. Watson has suggested an ingenious method by which a piece of rubber

drainage tube, ten to twelve cm. and of slightly less calibre than the catheter employed (so as to grip it firmly), is passed over this latter, the drainage tube being split longitudinally into two halves up to within twenty-five mm. of its outer extremity, and these lateral halves then being attached to the penis by adhesive plaster in the usual manner. Mercier and English catheters may be fastened in by means of a ligature or safety-pin as already described; while a metal instrument is best secured by passing the middle tails of a double T-bandage through the rings on each side of its shaft.

The period during which the same catheter can be safely retained without changing varies much in different cases, and depends largely on the state of the urine; in some patients the catheter will within forty-eight hours become so incrusted with salts as to make its removal difficult. It appears that instruments made of webbing are more liable to the deposit of salts than the soft-rubber catheter, and this constitutes another objection to their use for such purposes. Even when no such trouble arises, the irritation to the urethra or bladder, or the pain experienced by the patient may render the removal of the catheter imperative within a comparatively short time. As a rule, one should not be left longer in place without changing than a week or ten days, unless surety exists that no crusts are forming. This question is best determined by previous experience with the same patient, although the condition of the urine may serve as a fairly reliable guide.

When changed at suitable intervals permanent drainage by a catheter may be continued almost indefinitely. Thus Bazy kept a Nélaton catheter in the bladder for eighteen months, the patient not being confined to bed.

In some patients a catheter will not stay in place; it seems to work its way out either spontaneously, or slips from the urethra every time the patient changes his position in bed; while in others a catheter will stay securely in the bladder even when the patients are up and about, and leading a fairly active life.

When from any cause the catheter cannot be retained in the urethra and drainage of the bladder still continues to be indicated, cystostomy must be done. In a certain proportion of cases immediate incisional drainage of the bladder is indicated, not however to relieve cystitis alone, but to insure against continued back-pressure on the kidneys. Cystostomy has indeed become, in recent years, a preliminary step in the operation of suprapubic prostatectomy, but we still cling to the belief that the two-stage operation is indicated in only a certain proportion of

cases and that the proper use of the in-dwelling catheter will reduce the proportion of such cases considerably. The two-stage operation is really a development of the idea which was first expressed by Reginald Harrison of treating suppurative nephritis by means of perineal cystostomy. Cabot, of Boston, later proposed the treatment of patients with surgical kidneys by means of drainage of the bladder. Encouraging results were obtained by this method, and it soon became evident not only that obstructive lesions of the lower urinary tract caused grave disturbances in kidney function, but also that the relief of back-pressure by treatment preliminary to the removal of the obstructive factor permitted the restoration of kidney function to a degree that made the subsequent prostatectomy a much safer procedure. In certain cases the necessity for long-continued preliminary treatment, first perhaps by intermittent catheterization, later by in-dwelling catheter or by suprapubic cystostomy, is evident, but in a not inconsiderable number of patients whose disease is in the early stage, where the obstructive factor is not pronounced, and has given rise to little or no deleterious alteration in bladder or kidney function, we cannot see the rationale of subjecting the individual to a long series of treatments designed for the relief of something he does not suffer from. The two-stage operation should, in our judgment, be used only in selected cases.

Cystostomy is a very much safer procedure than tapping the bladder and allowing the cannula to remain in plcae; and besides being safer, affords the surgeon the additional advantage of digital or even visual examination of the interior of the bladder and the prostate, as well as enabling him to proceed to the formation of an artificial urethra, should such an operation be indicated at that time. As a rule, suprapubic drainage is to be preferred; but in certain cases the perineal route is the better.

Perineal drainage, so commonly employed in the early days of prostatic surgery, is now reserved for those fortunately rare cases of interstitial cystitis with great thickening of the bladder walls, and marked by diminished bladder capacity.

These cases are extremely difficult ones to treat and the results obtained are, to say the least, not brilliant. The suprapubic operation either for simple drainage or with the purpose in view, of some operative procedure on the vesical neck, is unsatisfactory on account of the great thickness of the bladder walls and the diminished bladder capacity.

Many forms of operative treatment have been suggested for this class of cases and, doubtless in certain instances, the Young punch

or Chetwood's galvano-cautery may be used with gratifying results. Our preference, however, is for perineal drainage with or without prostatectomy, as circumstances indicate.

In many of these cases the rigidity of the vesical neck is secondary to the chronic cystitis. The prostate is usually the seat of a chronic interstitial, inflammatory process, and is oftentimes small in size and very indurated; it may or may not be a contributing factor to the obstructive lesion at the vesical neck.

Operation should not be attempted in these cases until every effort has been made to bring some measure of relief by urethral dilatation, lavage of the bladder, etc.; but having failed in these attempts it behooves the surgeon to try some form of operative treatment.

It is our practise in operating upon these individuals to open the perineum, and if conditions warrant it, to remove the prostate gland; otherwise, the vesical neck is merely dilated and a drainage tube of large calibre is inserted.

This procedure insures temporary relief, the duration of which is almost in direct ratio with the length of time that the drainage is continued, and the care with which the post-operative treatment is carried out.

Perineal drainage as a preliminary step to the operation of prostatectomy is no longer employed; in the presence of violent intractable cystitis, with the exception just noted, the two-stage operation of suprapubic prostatectomy is indicated.

Retention of Urine.—(*a*) *Acute Complete Retention of Urine.*—This variety of urinary retention in prostatics is quite as serious an affection as strangulated hernia, and requires quite as prompt and efficacious treatment. The bladder may be very greatly distended by a small quantity of urine since it may have been chronically contracted and inflamed for a long time. The pain is indescribably terrible, and instantly grows worse; not only is rupture threatened every moment, but the damming up of the urine into the ureters and kidneys renders urinary fever and uremia likely; and even if rupture of the bladder does not occur, peritonitis by contiguity may soon develop. Since, moreover, the most usual cause of this form of retention is a mechanical obstruction caused by congestion of the prostatic urethra or the vesical neck, which congestion grows worse every moment the retention is not relieved, it is evident how idle it is to resort to those remedies, such as opium and the hot bath, which are so successful at times in the treatment of acute urinary retention due to spasmodic or even to organic

stricture. In patients of the latter class the retention is rarely absolute —usually a few drops trickle through the strictures now and again; and the bladder, moreover, is apt to be in a less unhealthy state than where prostatic disease has existed for a long time.

Hence the only rational treatment for this serious complication is immediate relief by the catheter. It is very rarely indeed that a catheter cannot be introduced, provided no false passages have been made in careless and forcible attempts to gain entrance to the bladder before the case is seen. The patient himself, in his agony of pain and imperative desire for relief, may have produced false passages which even the most skillful catheterization will be unable to elude; or another practitioner with greater zeal than dexterity may likewise have rendered the urethra impassable. But in virgin urethras, which have not before had a catheter passed, and where no strictures are present, a little persistence, and a good deal of patience and gentleness, will almost invariably accomplish the desired result.

The soft-rubber catheter is to be tried first; this failing, the Mercier should be introduced, and its elbowed beak made to follow closely the roof of the urethra; should this also be met by an insuperable obstruction, the English webbed catheter, moulded to a proper prostatic curve, may be tried, first alone, and then with its stylet. If passed with the stylet in its interior, the beak of the English catheter may usually be lifted over the raised vesical orifice of the urethra by partially withdrawing the stylet, as already described. When efforts thus conscientiously made also fail, metallic instruments may be tried; but we believe that a skillful surgeon will rarely succeed with these where he has failed with the English catheter mounted on the stylet. A hasty and impatient surgeon will no doubt often succeed in introducing by force, perhaps by tunnelling the prostate, a metallic instrument into the bladder, where a little more dexterity and less force would have brought the same result to pass by means of a semiflexible instrument and without injury to the bladder, prostate, or urethra.

Where strictures render the urethra difficult to catheterize, the usual manipulations employed in such cases should be employed. These it is not necessary to describe in the present work. It seems scarcely requisite to add that wherever in genito-urinary surgery a catheter has been introduced only with the greatest difficulty, it should be allowed to remain permanently in the bladder until all acute symptoms have subsided.

If, finally, no judicious efforts succeed in gaining entrance to the

bladder through the urethra, the bladder must be tapped. The time during which urethral instrumentation should be persisted in will, of course, vary somewhat with different cases; but, as a rule, we do not think such attempts should be prolonged more than a half hour or forty-five minutes. Even this length of time will be injudicious where the retention has lasted for more than a few hours at most.

While we recommend tapping of the bladder as the next step, we recognize that it must be only a temporary expedient; since it is very exceptional for the power of voluntary micturition through a urethra so much wounded and inflamed as these usually are, to return within any reasonable time; indeed, as already pointed out, where this acute retention is allowed to exist for any length of time, it is not impossible, indeed scarcely unusual, for chronic complete retention to follow from atony of the bladder; so that where a competent surgeon is in attendance, and the surroundings make it suitable, it is best to do a suprapubic cystostomy at once; or if the bladder is very small and the abdominal walls thick, perineal drainage may be established, as indicated in the last section.

But where no facilities for such operations exist, the bladder may be safely punctured suprapubically, and immediate danger averted, and the patient's pain temporarily relieved. This procedure may be repeated a number of times without evil consequences, but, as long ago pointed out by Dittel, such treatment is really only a pastime for the surgeon, and is one which should be tolerated only until proper arrangements for cystostomy can be made. When the resort to cystostomy must be delayed, it may appear better to retain the cannula in the puncture than to reintroduce it every few hours.

In cases of acute retention it is absolutely unjustifiable to extend the palliative operation of cystostomy to the radical removal of the prostate.

(*b*) *Chronic Complete Retention of Urine.*—If atony of the bladder exists in cases of this variety, as can readily be determined by the degree of force with which the urine is expelled through a catheter, it will be proper to make use of drainage of the bladder by a permanent catheter, in the hope that the chronic retention may be due to the atony alone, and not to mechanical obstruction by the enlarged prostate. By this method the bladder walls may in the course of a few weeks recover their contractility, as evidenced by increasing force in any stream (whether of urine or irrigation fluid) expelled through the catheter. If the atony is thus relieved, it still remains to determine whether

the mechanical prostatic obstruction is too great to be overcome by the restored bladder contractility. This question is readily answered in the affirmative if, on discontinuing the permanent drainage, the retention persists. In some exceptional cases it will have been found at the very outset that no atony of the bladder existed. Under either of these circumstances, then,—whether vesical atony never existed, or whether it be easily recovered from after relief of intravesical pressure by permanent drainage,—it is evident that the retention is due to mechanical prostatic obstruction. Hence the indication is to remove this by radical operation.

If atony did exist, and was not relieved after permanent drainage, we are confronted with another problem: Will removal of the prostate be any more apt to relieve the vesical atony than was the drainage of the bladder through the catheter? We think this question may fairly be answered in the affirmative; although we would hesitate to recommend radical treatment to a feeble patient whose catheter life was satisfactory to him. For there would still remain the risk that the radical operation would leave him no less dependent on the catheter than he previously was; but if his catheterism is painful, difficult, or unduly frequent, and the patient himself is not too old and feeble for any operation, we would be inclined to advise him to take the risk.

(*c*) *Chronic Incomplete Retention of Urine without Distention of the Bladder.*—Much of what has been said in the early part of this chapter under the general heading of catheterism applies to this complication. It is a nearly invariable accompaniment of every case of enlargement of the prostate.

(*d*) *Chronic Incomplete Retention of Urine with Distention of the Bladder.*—For these patients the indications are first to restore the full measure of vesical contractility, and then to remove, if necessary, the obstructing prostate.

The proper treatment to be advised for prostatics with overflow from retention, is to remove only a few—120 to 180—cc. of urine at a time, repeating this procedure every four or five hours as may be required, and thus gradually to empty the distended bladder in the course of two or three days. Or, if desired, more urine may be withdrawn, and partially replaced with saline or boric acid solution.

The above plan of treatment presupposes that the urethra is freely open to catheterization. But this may not be the case, the urethra

being obstructed by strictures or false passages. If a catheter can be introduced, but only with difficulty, the surgeon may try to clamp it, and leave it *in situ*, allowing a few cc. to run off by removing the clamp every couple of hours. But if no catheter of any kind can be introduced, a filiform bougie should be tried, as in the case of stricture unaccompanied by prostatic enlargement; when success attends these efforts, the filiform should be left in place, as the urine will satisfactorily and not too rapidly drain off along its track. If no kind of instrument can be introduced, we believe the proper course for the surgeon to pursue is to perform suprapubic cystostomy, evacuate the urine, staunch bleeding from the mucous membrane of the bladder by the hot douche; and take the usual constitutional precautions against the development of surgical kidney and uremia.

Aspiration or tapping of the bladder may be thought by some a preferable course, only a few cc. being removed each time, and the operation being repeated innumerable times; but such a plan of treatment admits of no hope to the patient save the classical "meditation upon death;" for it is the most improbable thing in the world that the urethra will again become open to instrumentation before the "meditation" of the patient has passed into the reality. Suprapubic cystotomy under local anesthesia is the method of choice in the treatment of these cases, not only because it is the safest and best method of relieving the acute retention when catheterization is impossible, but also because it offers the best means of decompressing the kidneys.

Cystostomy under these circumstances constitutes the first stage of the two stage prostatectomy. In rare instances, however, the condition of the patient following the operation will not improve sufficiently to justify removal of the prostate; he can then be provided with a cannula to be worn permanently in the fistula.

Calculus.—The most generally accepted plan of treatment for calculus complicating enlargement of the prostate is suprapubic lithotomy. In suitable cases the prostate may be removed at the same time, but it is generally advisable to drain the bladder for a time before attempting prostatectomy. The latter operation should not be undertaken until the kidney and other vital functions have been restored to as near the normal as possible. Preliminary drainage of the bladder not only aids in such restoration of function, but serves also to relieve the cystitis which usually accompanies stone, and thus minimizes the dangers of sepsis and hemorrhage after prostatectomy.

It is sometimes stated that patients with enlarged prostates com-

plicated by stone bear operation better than those in which stone is not a complicating factor; this view is erroneous in our experience and we can find no statistical confirmation of it.

Not a few successes have been reported from operation by litholapaxy but the operation is not to be employed in patients with marked intravesical projection of the prostate.

We have long since abandoned the operation of litholapaxy yet this procedure with or without a Young punch operation may possibly have a place in the treatment of small stones complicating median bar formation or sclerosis of the vesical neck.

An alternative method of treatment in cases of this kind is that of median perineal lithotomy followed by galvano-cauterization of the vesical neck. (Chetwood.)

Orchitis is to be treated as when arising from other causes. Instrumentation should also be discontinued.

Hemorrhage into the bladder is best treated by hot irrigations, and permanent drainage, which may be instituted by means of a suprapubic wound if necessary.

Renal Complications and Uremia.—For these complications the treatment in patients with enlargement of the prostate does not differ materially from that habitually employed in other cases. Good bladder drainage is imperative. The permanently retained catheter, or suprapublic or perineal drainage, may be employed, according to the principles already laid down. If polyuria is a distressing feature it may be partially relieved by reducing the amount of fluid ingested, and by promoting perspiration. Care should be exercised that atony of the bladder from overdistention does not arise.

In the later stages of renal affections, when the urine becomes scanty or suppressed, the usual increase in ingested fluid should be prescribed; and great advantage may be derived from the use of saline solution by the bowel. A half litre is readily absorbed from the colon in the course of an hour or so; the temperature should be over 100° F. In sudden emergencies intravenous infusion of the decinormal salt solution may be employed, it being rarely advisable to give more than one or two litres at once by this method. This fluid is probably absorbed nearly as rapidly from the bowel as when given intravenously, and certainly more rapidly than when administered by hypodermocylsis.

The steam bath should be employed in case of uremia, or when it is not available, pilocarpine should be given hypodermatically. The tendency which this drug is said to possess of producing or at any rate

favoring edema of the lungs is against it; but in so great an emergency as uremic coma this risk may be taken. The hydrochlorate is the best salt, and is prescribed in doses ten to fifteen mgms. Digitalis is of use in increasing the action of the kidneys and heart. Sparteine is also an efficient diuretic. Sparteine and caffeine given together are at times beneficial. The sulphate is employed in doses of 30 to 120 mgms.

Dry cups applied over the loins may sometimes be of service.

Acidosis.—The exact symptoms which an uncompensated acidosis produces in any given individual are difficult, if not impossible, to define; for acidosis is present only in connection with, or as a result of, more or less grave conditions. It can be expected, however, from results of experimental procedures on controlled isolated phenomena, that the condition will be productive of unfavorable symptomatology. As a result of studies on large numbers of operative cases with due allowances for differences in individuals, in pathology, and in operative procedures, it seems fair to postulate that excessive nausea and vomiting, gas pains, restlessness, and similar symptoms, are often accompanied by uncompensated acidosis. The type of patient presenting an enlarged prostate is one in which it is very likely to occur. The individuals are older, have usually been ill for a considerable time; many, if not most, have some form of nephritis varying in grade, together with arteriosclerosis, and a damaged myocardium. The mechanism by which an anesthetic, ether for example, changes the carbon dioxide of the blood has been studied in some detail. In the management of this condition, prevention, as in so many other cases, is far more important than cure. A general scheme which has given satisfaction is as follows:

At the same time that blood is secured for the determination of blood urea and other substances, enough is taken with proper precautions to determine the carbon dioxide combining power of the plasma. The danger point is 50 cc. of carbon dioxide per 100 cc. of plasma. Below this, uncompensated acidosis is said to exist. The decrease in the carbon dioxide combining power due to anesthesia and operation has been found to be from 5 cc. to 15 cc. To assure that the safe level is maintained, it is well to give alkali, *e.g.* sodium bicarbonate, to those individuals showing an original carbon dioxide combining power of 60 cc. carbon dioxide, or less.

The necessary dose can be calculated by the use of a formula:

1 gm. of sodium bicarbonate when neutralized will yield 267 cc. of carbon dioxide.

For every kilo of body weight, there are approximately 700 gm. of fluid.

Consequently, the amount 1 gm. of sodium bicarbonate will increase the carbon dioxide of the plasma of an individual weighing 1 kilo per 100 cc., will be $\frac{267}{7}$.

Consequently, x will equal $\frac{38g}{w}$, where x stands for the desired increase per 100 cc. of plasma, g the number of grams of sodium bicarbonate, and w the weight of the individual in kilos.

If, therefore, preliminary analysis has shown the carbon dioxide capacity of the plasma to be 55 cc. carbon dioxide per 100 cc., and it is desired to increase to 70 cc. in an individual weighing 75 kilos, the amount of sodium bicarbonate necessary will be

$$g = \frac{xw}{38} = \frac{15 \times 75}{38} = \text{about } 30 \text{ gm.}$$

The maximum effect of a single dose by mouth is reached in about two hours; but it can be given in hourly doses ending about two hours before operation.

Rectal administration may be used after operation either intermittently or constantly in 4 per cent. solution.

With these precautions, trouble from acidosis *per se*, may be entirely avoided. If doubt is present at any time, determinations can easily and quickly be made.

Attention is here also called to too much alkali, and while alkalosis has not received the same amount of consideration accorded to acidosis, it perhaps is as well not to administer too much, *i.e.*, the carbon dioxide carrying power of the plasma should never be above 75 cc. carbon dioxide per 100 cc.

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CHAPTER XI

PALLIATIVE OPERATIONS INCLUDING CYSTOSTOMY, YOUNG'S PUNCH OPERATION, CHETWOOD'S OPERATION, AND FULGURATION

The history of the development of the operations of suprapubic and perineal cystostomy by simple puncture has been dealt with elsewhere. Perineal puncture has been universally abandoned, while tapping the bladder suprapubically is merely a palliative measure for use in cases in which the urethra is impassable, and where other means of relieving the retention are not available.

Lower, of Cleveland, has suggested the use of the trocar and cannula to take the place of the more formal cystostomy, not only for the purpose of providing suprapubic drainage in inoperable cases, but also as the initial step in the two-stage operation of prostatectomy in certain circumstances that preclude a more radical procedure. The simplicity of this method and the satisfactory results that follow its use should make it, according to Lower, the method of choice in selected cases.

The Trocar and Cannula Method of Lower.—Lower has recently called

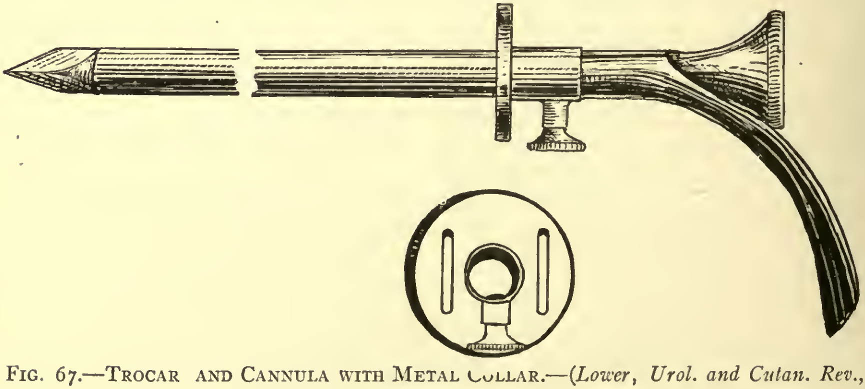

FIG. 67.—TROCAR AND CANNULA WITH METAL COLLAR.—(*Lower, Urol. and Cutan. Rev.,* 1914, xviii, 6.)

attention to a method of draining the bladder by means of the trocar and cannula which undoubtedly has many advantages over simple puncture. The senior author used this same method many years ago before the operation of cystostomy was fully perfected; he believes that it has a place in the treatment of certain desperate cases of enlarged

prostate with acute retention in which almost any operative interference would be attended with grave danger. The method provides not only for relief in cases in which relief is urgently demanded, but provides in addition for permanent drainage of the bladder. It may be used as a substitute for the ordinary cystostomy and has the advantage over simple puncture in that it practically eliminates the danger of urinary infiltration in the abdominal parietes.

Lower states that the trocar and cannula method often proves to be a more comfortable way of providing bladder drainage as a preliminary to prostatectomy than the use of the catheter *per urethram*. We cannot see the advantage of this method over formal cystostomy except in cases of acute urinary retention in which catheterization is impossible, and in which even so slight an operation as cystostomy under local anesthesia would be attended by grave danger.

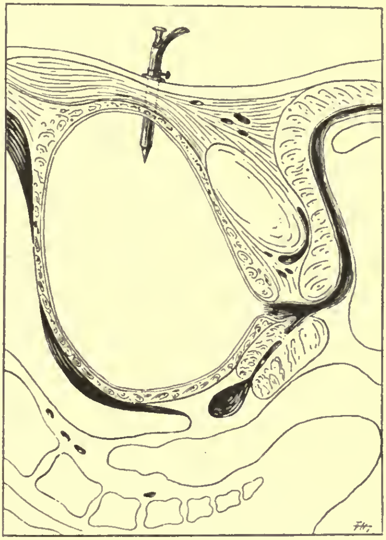

Fig. 68.—Lower's Trocar and Cannula Method.

Step 1. Trocar introduced into Bladder.—(*W. E. Lower, Urological and Cutaneous Review.*)

The uncertainty of the location of the opening in the bladder, the small size of the fistula which prevents digital exploration of the bladder, the fact that it provides inadequate drainage and renders the subsequent removal of the prostate difficult, are the great disadvantages of the trocar and cannula method.

This method may be used to advantage, however, in establishing a urinary fistula for the treatment of certain inoperable cases.

Technique.—The trocar and cannula are forced into the bladder a ta point sufficiently distant from the pubis to avoid puncture of the plexus of veins which lies just behind the pubic bone. A local anesthetic may be used but is ot essnential. The bladder must be sufficiently distended to displace the peritoneum out of harm's way. The trocar is withdrawn leaving the cannula in place and through the latter a sterile, No. 14 (F.), soft rubber catheter is inserted into the bladder cavity. The cannula is then withdrawn over the catheter which is allowed to remain in the bladder.

The after-treatment is essentially the same as with other forms of suprapubic drainage operations. In the subsequent removal of the prostate it is necessary greatly to enlarge the opening and in so doing it must be remembered that the original opening is located at a point more distant from the summit of the bladder than is the case with the ordinary cystostomy wound.

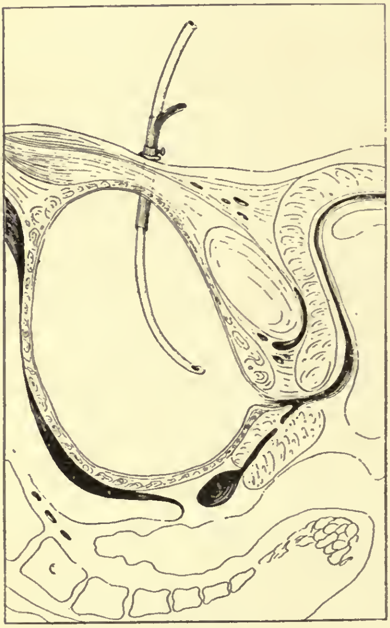

FIG. 69.—LOWER'S TROCAR AND CANNULA METHOD.
Step 2. Catheter Introduced into bladder through the Cannula.—(*Urological and Cutaneous Review.*)

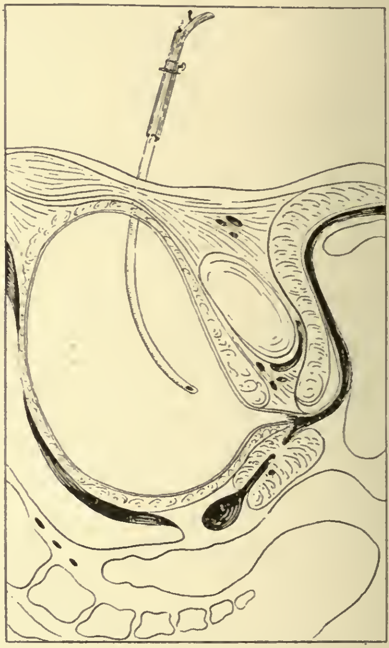

FIG. 70.—LOWER'S TROCAR AND CANNULA METHOD.
Step 3. Cannula withdrawn leaving Catheter in Bladder.—(*Urological and Cutaneous Review.*)

In cases in which prostatectomy is contraindicated, and in which permanent drainage is necessary, the fistulous tract may be fitted with a metal cannula with urinal attachment, or the cannula may be fitted with a cork which can be removed when the desire to urinate is felt.

Gibson's Operation.—The formation of a bladder valve, as devised by Gibson, for the treatment of inoperable carcinoma of the bladder and prostate is likewise useful in a very limited group of patients with benign prostatic hypertrophy. This group includes only those cases in which the absolute impossibility of subsequent removal of the prostate can be predetermined. This is a necessarily limited group,

because one can rarely be sure, however desperate the condition of the patient may be before drainage of the bladder is provided, that the vital functions will not be sufficiently restored as the result of such drainage to justify the attempt to remove the prostate at some later time. The Gibson operation is applicable only to patients with a reasonably large bladder capacity. The operation is performed as follows:

The bladder is exposed suprapubically in the usual manner. An incision large enough to admit a catheter, No. 30 French scale, is then made into the bladder at its midpoint. A No. 30 soft rubber catheter is inserted through the incisional opening into the bladder and anchored to the margins of the incision which is then closed above and below the catheter. Two Lembert sutures are now passed through the bladder wall above and below the catheter, these sutures being so placed that an infolding of the bladder wall will occur when they are tied; the portion of the bladder wall between these sutures is thus invaginated into the bladder cavity, carrying the catheter with it.

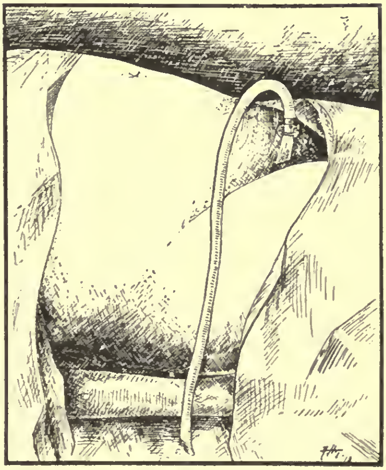

Fig. 71.—Lower's Trocar and Cannula Method.

Step 4. Catheter fixed in position. —(*Urological and Cutaneous Review.*)

Additional Lembert sutures are inserted and tied so that further invagination of the bladder wall is produced with the result that a valve-like fold is formed. The suture material recommended is No. 2 chromic catgut. The abdominal wound is closed with through and through sutures of silkworm gut. The steps in the operation are clearly shown in the accompanying illustrations.

The after-treatment consists in the removal of the catheter as soon as absorption of the retention sutures has occurred, usually at the end of the first week, with the substitution of a No. 23, soft rubber catheter. This is replaced about the end of the second week by a No. 20 catheter; with the contraction of the fistula to this size the bladder valve becomes retentive.

The subsequent care of the fistula is simply a matter of cleanliness

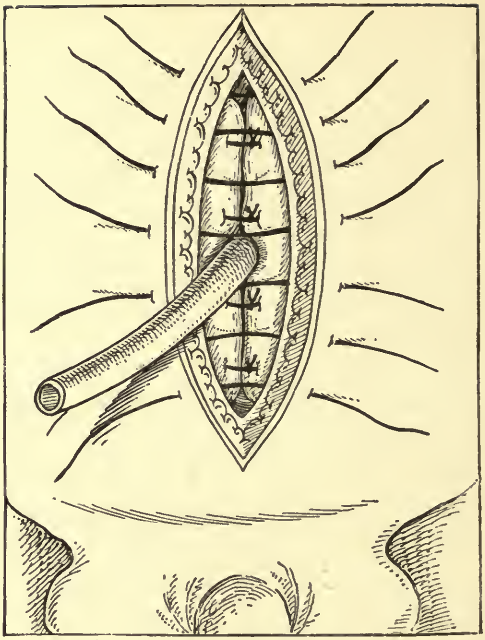

FIG. 72.—GIBSON'S OPERATION.
Step 1. (*Ramon Guiteras, A Text-book of Urology, D. Appleton and Co.*)

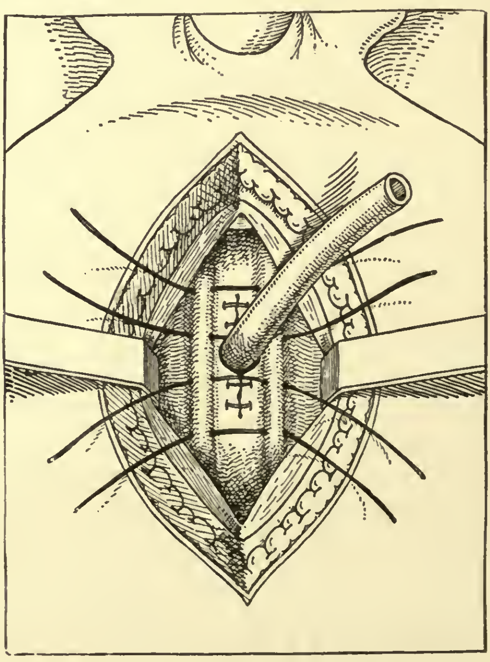

FIG. 73.—GIBSON'S OPERATION.
Step 2. (*Ramon Guiteras, A Text-book of Urology, D. Appleton and Co.*)

except if it shows a tendency to close in which event dilatation is necessary. The Oberlander dilator is recommended for this purpose athough straight, olivary tipped urethral bougies of the woven variety may be used with equal satisfaction.

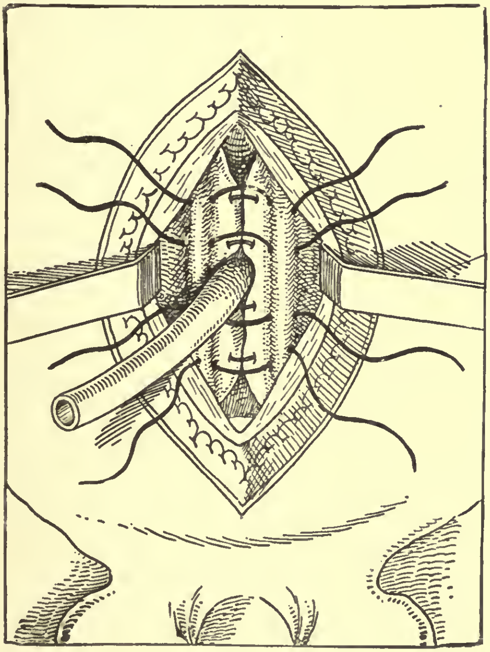

FIG. 74.—GIBSON'S OPERATION.
Step 3. (*Ramon Guiteras, A Text-book of Urology, D. Appleton and Co*).

The bladder valve permits the easy removal of residual urine per catheter. Leakage of urine does not occur, and the patient can void normally if the urethra is patulous. If, for any reason, the use of the normal channel is undesirable the bladder may be emptied at regular intervals by simply inserting a soft rubber catheter through the valvular opening.

The Gibson operation is, as we have already stated, rarely indicated in cases of benign prostatic hypertrophy, but it is enimently suited to that small group of cases in which prostatectomy is contra-indicated and in which a false urethra must be provided. It is not to be employed as a substitute for catheterism, but only in cases where the latter has been tried unsuccessfully, where prostatectomy is out of the question, and where the valve operation seems to be superior to the ordinary suprapubic operation of cystostomy as a means of providing the necessary false channel for evacuating the urine.

INTRA-URETHRAL OPERATIONS FOR THE RELIEF OF OBSTRUCTIONS AT THE VESICAL OUTLET

The development of urethral instruments and the technique of their employment for the relief of obstructions at the vesical outlet are discussed at some length in Chapter I. There will be found descriptions of some of the instruments and methods that are now employed, in a modified form it is true, but still the same in principle, for the removal, or destruction of various obstructing factors in this locality.

Much confusion characterizes the attempts made to separate these conditions into pathological entities separate and distinct from diseases of the prostate gland; clinically they give rise to a syndrome that is identical with that arising from true prostatic hypertrophy.

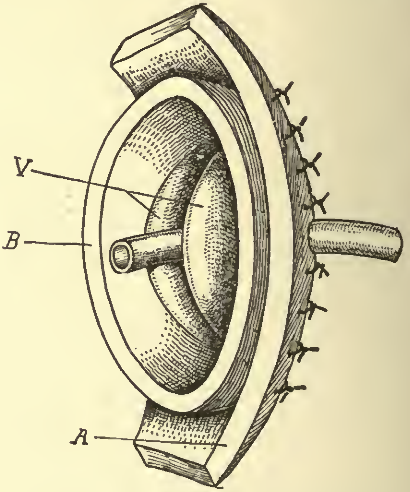

FIG. 75.—GIBSON'S OPERATION. Diagram showing the Infolded Bladder Wall forming a Valve.

The expert cystoscopist can form a rather precise idea of the nature of the lesion in any given case, and of the method of treatment particularly adapted to its removal; the average surgeon, however, must rest content with the knowledge that an obstructive lesion exists which is organic but not neoplastic in nature, and probably not of prostatic origin, or at least not associated with generalized benign hypertrophy of the prostate gland. He will realize also that prostatectomy may or may not be necessary to remove the obstruction.

The diagnosis and pathological description of the conditions to which we now refer are given elsewhere, suffice it to say here that they are variously known under the terms, "contracture of the vesical neck, median bar formation, submucous fibrosis, atrophy of the prostate, prostatism sans prostate, hypertrophy of the subcervical (Albarran's) glands, hypertrophy of the subtrigonal glands, isolated fibro-adenomata of the prostate gland, median lobe enlargements, etc."

Practically all of the modern instruments used in the treatment of the aforementioned conditions are, in principle, quite similiar to others

which have long been discarded. Thus the punch devised by Young is very similar to Mercier's prostatectome, a picture of which is shown in Chapter I. Mercier's instrument was introduced into surgery in 1839 but was soon forgotten. This antedated the modern cystoscope by many years and doubtless the improper selection of cases explained in part the failure of Mercier's method, which enjoyed but a brief popularity.

Chetwood's galvano-cautery is in principle the same as the galvano-cauterization of Bottini, to which however it is vastly superior.

Finally, the high-frequency spark operation introduced by Bugbee is a refinement of the method advocated by Wossidlo; the latter attempted, but without much success, to combine in one instrument the cystoscope with the galvano-caustic incisior, and to this instrument he gave the name of "Incision Skystoskop."

The trend of modern surgery in the treatment of these cases is undoubtedly toward suprapubic operation notwithstanding the claims made by the advocates of the palliative forms of treatment. We believe that the prostate should not be disturbed in cases where it in no way contributes to the existing obstruction at the vesical outlet. But we believe also that in the hands of the average surgeon, and this includes the great majority of specialists, better results will be obtained by opening the bladder suprapubically and removing the obstructing element with the knife or rongeur than with from any form of intra-urethral operation.

In certain cases we have performed perineal prostatectomy but the results were not entirely satisfactory; this applies especially to those cases in which there is a widespread fibrosis in the region of the vesical neck associated perhaps with interstitial cystitis. In the treatment of these and other cases in which we formerly used the Bottini incisor, we now prefer the suprapubic operation with removal of the obstructive elements by means of the rongeur forceps, scalpel, or scissors. The choice of the method to be employed is made after the bladder is opened, and in many instances the final judgment is for prostatectomy in cases in which simple excision of a median bar or other extra-prostatic lesion seemed to be indicated by cystoscopic examination. It is not good surgery, in our judgment, to do a punch operation for the purpose of providing temporary relief from a condition that will later demand a radical operation. The punch operation may be used to advantage in cases in which under more favorable circumstances prostatectomy would be indicated and, judging from the results of this operation as

reported by Young and others, a great deal of good may be accomplished, even though a complete cure is not obtained.

We prefer, as previously mentioned, the suprapubic operation with excision of the obstructing element and would limit the use of intra-urethral operations to those cases in which the more radical form of treatment is for any reason contra-indicated.

Electric Cauterization of Obstructions at the Vesical Outlet by means of the high frequency current has been given some prominence lately by Bugbee and his followers. Originally this method was said to be applicable to the same class of cases as the Young punch operation. More recently, however, Bugbee has expressed the view that the high-frequency spark is inferior to the Young punch since it is difficult to burn deeply into the products of inflammation surrounding the outlet of the bladder. The fulgurating or high-frequency current may perhaps be useful as a palliative if not curative method of treatment in the early stages of subcervical glandular hyperplasia. It may also prove to be an efficient means of relieving chronic congestive states of the mucosa in this region, but little can be hoped for in the treatment of true prostatic hypertrophy or submucous fibrosis. The high-frequency spark was suggested by Bugbee for the destruction of prostatic nodules remaining about the vesical neck after incomplete prostatectomy, and it is stated that partial relief was obtained by fulguration in these cases. An incomplete prostatectomy which fails to relieve the patient's sufferings is in our judgement a very definite indication for re-operation, provided the condition is not a malignant one. In the cases of this kind that we have re-operated, the condition of the tissues in the region of the outlet of the bladder was such that radical operation was obviously necessary. Cases have been reported, however, in which remaining nodules of prostatic tissue and obstructing folds of mucous membrane were successfully removed with the Young punch.

Technique.—The nature and location of the obstructive lesion is determined in preliminary cystoscopic studies, for which the cysto-urethroscope is the most satisfactory instrument both for examination and treatment..

Having decided upon the nature of the lesion and the location of the areas where the cauterization is to be applied, the cystoscope is introduced into the bladder cavity, With the beak of the instrument in the partly distended bladder, the electric wire is introduced until it appears in the field and is then further advanced until at least one half inch projects from the window of the cystoscope. The irrigating

fluid is then permitted to flow slowly into the bladder and at the same time the cystoscope and the electric wire are slowly withdrawn until the area to be treated appears within the field of vision. If this is on the floor of the sphincteric margin, the instrument is held against the roof of the urethra by depressing its ocular end, and a similar procedure will aid in bringing other areas more clearly into view.

When the obstructive lesion has appeared in the field, the instrument is further withdrawn, but only for a very short distance, and the deflector is turned, whereupon the tip of the wire will be seen to touch the diseased area.

Some cystoscopists advise that the lesion be located before the wire is made to emerge from the sheath of the cystoscope, but we have found it much easier to place the wire in the proper position with the technique just described.

The Oudin (unipolar), or the d'Arsonval (bipolar), current is used and the spark is applied for variable periods of time, usually one minute, depending upon the strength of the current and the depth of the tissues to be destroyed. Several weeks are required for the sloughs to separate. The frequency of the treatments must be guided by the tolerance of the individual patient to instrumentation. As a rule, it is unwise to repeat the cauterization until the slough caused by the first treatment has come away and the ulceration has begun to heal. Repeated cauterizations are usually necessary before definite improvement is noted.

Young's Punch Operation.—Under the title "A New Procedure (Punch Operation) for Small Prostatic Bars and Contractures of the Prostatic Orifice," Young of Baltimore, in 1913, presented to the profession a new method of treatment for the particular groups of cases now under discussion.

This method is, in principle, that described many years ago by Mercier, but it remained for Young not only to perfect the instrument, but to clearly define the group of patients suffering from obstructions at the vesical neck to which the punch operation is applicable. He further subdivided these cases into groups, showing the method of applying the punch in each group and the results that might be expected to follow.

The punch operation has met with more general acceptance than any of the other intra-urethral methods of treatment, if we may judge from the reports in the literature, although it has by no means met with the enthusiastic support of the large majority of surgeons. We have had no experience with the method, prefering instead the

suprapubic operation in those cases in which the punch operation might be thought to be appropriate. The following remarks are based entirely on data contained in the literature.

At the time of the first report (1913), Young had performed the operation in approximately one hundred cases, which number has been considerably increased since then. The first group of cases were classified as follows:

(*a*) Median bar obstruction	51
(*b*) Prostatic bar or contracture with diverticulæ	5
(*c*) Prostatic bar or contracture with calculus	11
(*d*) Prostatectomy cases with incomplete results	20
(*e*) Median bar with trigonal elevation and obstruction	3
(*f*) Spinal cases with large amounts of residual urine (associated with median bar)	3
(*g*) Obstruction associated with carcinoma (vesical or prostatic)	9

Results. Class (*a*) 51 cases.—The results were entirely satisfactory, there were no fatalities and the only immediate post-operative complication was hemorrhage. This was never alarming however and never necessitated opening the bladder to control it. The end-results were likewise satisfactory.

Class (*b*) 5 cases.—Young's experience in this group of patients led him to remark that simple removal of the obstruction either by prostatectomy, or by the punch operation relieved the patient and that excision of the diverticulum is unnecessery except when the ureter is interfered with. In our experience the removal of the obstruction does not greatly benefit the patient with a large diverticulum. If such patients can be kept in comparative comfort by palliative means it is better, in our judgment, to withhold operation even though the ureter is drawn into the sac of the diverticulum.

Class (*c*) 11 cases.—Young is particularly enthusiastic over the results of the punch operation in cases of median bar complicated by stone. The stone is crushed and removed, and following the litholapaxy the median bar is punched out thus removing the cause of stone formation in this particular group. All of the patients were cured and none had a recurrence of the stones.

Class (*d*) 20 cases.—This most interesting group of cases, the details of which are described in the "Transactions" of the Section on Genito-Urinary Diseases of the American Medical Association, 1912, were operated upon with the "punch" and with most gratifying results. The type of obstruction and its location with reference to the various segments in the circumference of the vesical outlet was by no means

constant. In some instances the cystoscopic rongeur was employed to remove pedunculated or rounded nodules followed by the removal of the base of such lobe or nodule with the punch.

Class (*e*) 3 cases.—This group is of interest in that attention is drawn for the first time to trigonal elevation as a cause of urinary obstruction.

Class (*f*) 3 cases.—In only one of these cases was the removal of an obstructing median bar followed by a restoration of bladder function.

Class (*g*) 9 cases.—The punch operation is advised only as a palliative measure, the purpose of which is to remove a median bar obstruction complicating an otherwise inoperable carcinoma of the prostate. Since the publication of this preliminary report the punch has been used more extensively in this class of patients and with good results. It should not be used, however, to the exclusion of radium and other measures that may hold the disease in check.

Since the appearance of Young's report the punch operation has been used by many surgeons and the reports are on the whole encouraging, although no one seems to have had extensive experience with the method except its originator. Post-operative bleeding has been observed and in some instances this necessitated suprapubic cystostomy. Cunningham suggests the use of a dePezzer catheter after the punch operation. He claims that the button-like end of the catheter will exert sufficient pressure on the wound to control all dangerous bleeding. Cunningham states that he found it necessary on several occasions, before adopting the retention catheter, to do an external urethrotomy to control the bleeding. The introduction of a larger catheter through the perineal wound than could be introduced *per urethram* effectually controlled the hemorrhage.

Young originally advocated the use of a two-way catheter introduced through the urethra with continuous irrigation of the bladder after the punch operation, but in a more recent article he states that the hemorrhage can be controlled by the introduction of a single catheter the end of which is coated with cephalin, a hemostatic agent described by Howell.

Notwithstanding the interest in this subject that Young's work has stimulated, the literature contains comparatively few references to the punch operation. In practically all instances such references as are available refer to only a few cases. Young seems not to have changed his opinion regarding the merits of the operation, and it is interesting to review the later reports from his clinic. Among these may be quoted

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that of H. C. Cecil, who gave a resumé of the results of Young's operations before the Philadelphia Academy of Surgery in 1917. This report includes the late results in 128 cases, tabulated as follows:

70 patients	Cured
13 patients	90 per cent. improved
16 patients	75 per cent. improved
13 patients	50 per cent. improved
3 patients	25 per cent. improved
13 patients	Not improved

In the thirteen cases in which no improvement was noted after the punch operation, the symptoms were due to a contracted bladder. All of these cases showed median bars on cystoscopic examination, but the associated pathology in the bladder wall was such that the punch operation failed to effect a cure.

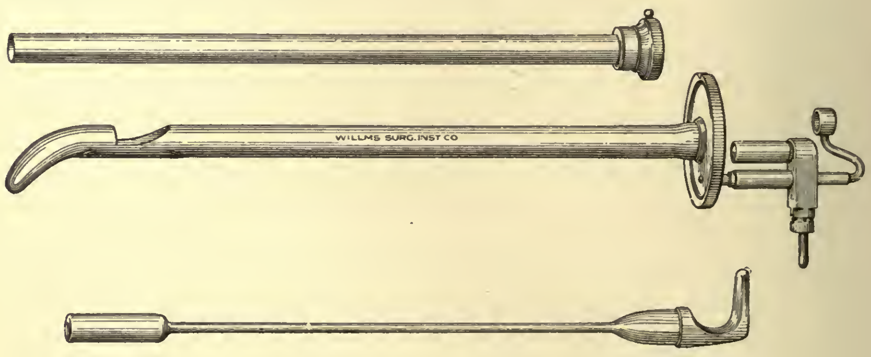

Fig. 76.—Young's Urethroscopic Median Bar Excisor.

In a detailed description of a very remarkable case, Young shows the possibilities of treatment with the combined use of radium, fulguration, and the punch in desperate cases of enlarged prostate. This report is interesting in that it shows how much can be done to relieve the sufferings of certain individuals in whom prostatectomy is absolutely contraindicated on account of cardiac or other organic defects.

Technique.—The instrument consists of two tubes which fit one within the other, and an obturator. The inner tube is hollow and has a sharp edge which serves as a knife to punch out any tissue that may appear through the fenestrum of the outer tube or sheath. The latter is provided with an opening on its convexity near the inner or bladder extremity. The latter end is curved like a coudé catheter. The outer end of the sheath is provided with a light-carrying attachment similar to that of the Young urethroscope.

The use of the urethroscopic light is unnecessary for locating the part to be removed; this should be done by cystoscopic examination before the operation is attempted. The exact position of the part to be operated upon being known, it is a simple matter to engage it in the fenestrum of the sheath by pushing the instrument into the bladder cavity whereupon urine will escape; by withdrawing the instrument until the flow of urine suddenly stops the bar is brought into the fenes-

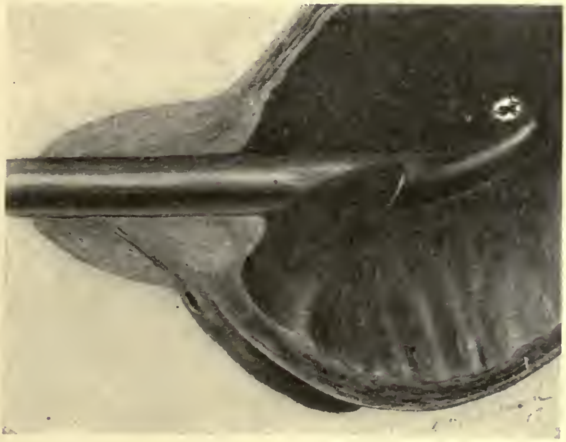

FIG. 77.—Median bar excisor or punch instrument introduced into the bladder; cutting inner tube withdrawn allowing fluid to escape, showing that the instrument is in the bladder. (*Hugh H. Young, Annals of Surgery*, 1917, lxxv, 1.)

trum and it is then a simple matter to insert the inner tube and punch out the desired amount of tissue. The procedure may have to be repeated several times before all of the obstructing tissue is removed. This procedure calls for familiarity with urethral instrumentation, but if the operator is possessed of sufficient skill to enable him to locate and recognize the bar and to bring it into the fenestrum under the guidance of the eye aided by reflected light, he is equally capable of accomplishing this by the manipulations just described.

The operation is performed with local anesthesia and with the bladder filled with a mild antiseptic solution.

When the bar is engaged in the instrument, the inner tube is pushed home, thus excising in one piece the tissues contained within the window of the tube. The inner tube contains the piece of tissue, which is removed with forceps. Young advises the removal of several additional segments of tissue at the lateral extremities of the bar.

The tissues to be excised may occupy the anterior or lateral portions of the vesical outlet and the position of the instrument must be varied accordingly.

The after-treatment consists of drainage of the bladder by a catheter of large calibre and lavage of the bladder to remove blood clots. As previously stated, Young recommends that the end of the catheter be coated with cephalin. This substance is dissolved in a small quantity of ether and the solution is slowly poured over the end of the catheter so that the ether will evaporate leaving a coating of cephalin on the instrument.

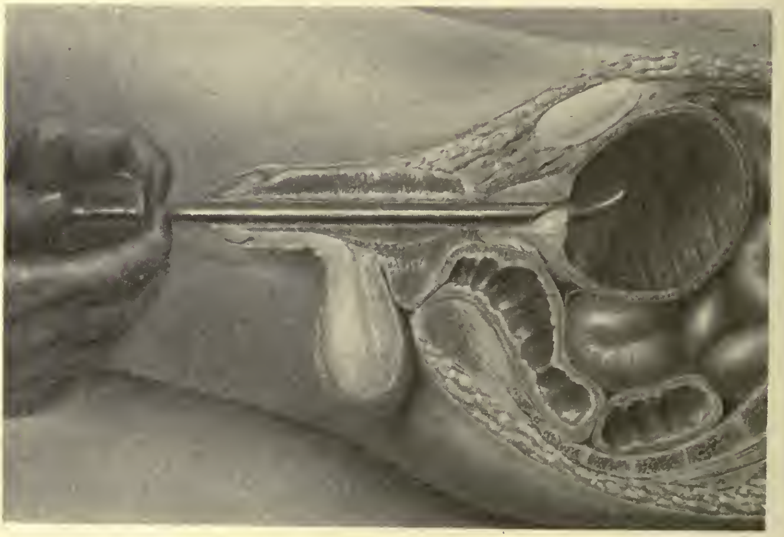

Fig. 78.—Instrument withdrawn until the Median Bar is Entrapped in the Fenestra when the Inner Cutting Tube is Quickly Pushed Inward to Excise the Bar.—(*Hugh H. Young, Annals of Surgery.*)

If blood clots collect in the bladder cavity they must be removed by aspiration with a Valentine or other suitable syringe. The catheter may be removed within twenty-four hours if the bleeding has ceased. Subsequent dilatation of the urethra is unnecessary.

Caulk has recently introduced a modified Young's punch in which a cautery blade takes the place of the cutting edge of the inner sheath of the Young instrument. The originator of this instrument reports a series of fifty cases in which the obstruction was relieved by electro-coagulation, with uniformly good results. The danger of hemorrhage after electro-coagulation are said to be *nil.*

Perineal Galvano-prostatomy (Chetwood).—Galvano-cauterization of the vesical neck through a perineal urethrotomy wound (Chetwood's operation) is a modification of the Bottini operation, the latter being

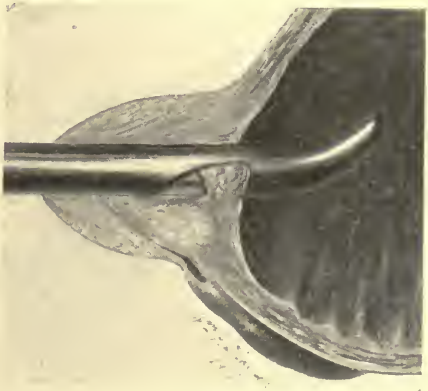

Fig. 79.—Cutting Tube Half Way through the Bar.—(*Hugh H. Young, Annals of Surgery.*)

also a galvano-prostatomy but is performed through the urethra without a perineal incision.

Both operations have been abandoned by the majority of operators

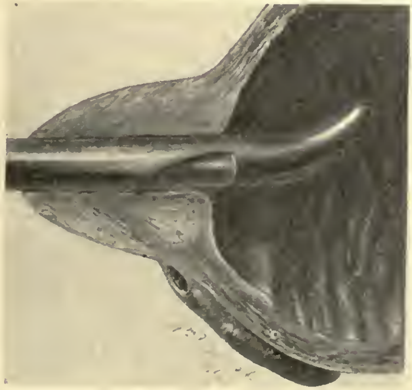

Fig. 80.—Cutting Tube pushed Home, Completely Excising the Bar.—(*Hugh H. Young, Annals of Surgery.*)

and especially is this true of the Bottini method. Chetwood and a limited number of other surgeons hold to the opinion that galvano-cauterization offers the best means of treating contractures or strict-

ures of the vesical neck, which conditions may or may not be a part of, or arise subsequent to, primary disease in the prostate gland.

The pathology of this condition, according to Chetwood, is not that of fibrosis alone, but one associated with what he terms circular or concentric hypertrophy of glandular prostatic elements which normally lie in juxtaposition with the sphincteric area of the bladder outlet.

Whether or not this is a true conception of the pathological change, the fact remains that there is a considerable group of cases in which an obstruction to urination exists at the bladder outlet which cannot

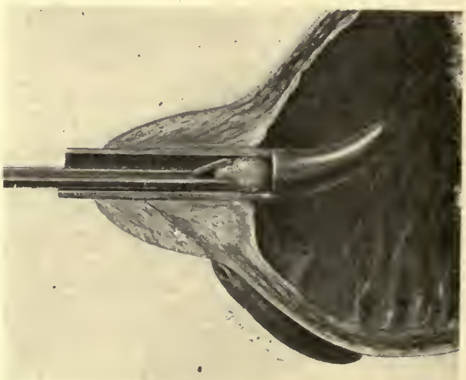

Fig. 81.—The Excised Bar Grasped in Tube with Intraurethral Forceps Previous to Removal.—(*Hugh H. Young, Annals of Surgery.*)

be relieved satisfactorily by removal of the prostate. To this group Chetwood believes the operation of galvano-cauterization is eminently suited. It will suffice to remind the reader at this time that we advocate suprapubic exploration of the bladder in this group of cases, with radical removal of the prostate if necessary, or with simple excision of a median bar, or isolated nodule of glandular tissue if these are found to be the cause of the obstruction to urination. It should likewise be noted that the Young punch operation was primarily intended for the treatment of the same type of patients.

Technique.—The following description of galvano-prostatomy is taken from Chetwood's text-book of Urology.

The instrument is composed of a handle and sheath and several sizes of cautery blades. The handle of the instrument is graduated so that the dimensions of the cut may be determined. The sliding of the knife is effected by traction instead of the rotation of a wheel, so that

the operator readily appreciates the progress of the blade and the density of the tissues during cauterization. One hand is required to operate the instrument and the index finger of the other hand is free to be introduced into the rectum. No cooling device is attached to the instrument. The circulation during the operation of a cold sterilized solution through the urethra and out through the perineal wound is required to keep the handle of the instrument cool without affecting the blade. The current is supplied by a storage battery or preferably from the street current with the aid of a motor transformer and rheostat. About 50 amperes are required to heat the knife to a white heat which is cooled to a certain extent as it passes through the tissues.

The patient is placed in the lithotomy position, the bladder having been previously washed with boric acid solution. The preliminary step of external perineal urethrotomy is performed. The bladder having been reached, the staff is removed and the finger introduced through the perineal opening. In cases of marked contracture, whether or not accompanied by hypertrophy, the vesical orifice may be too tight to admit the examining finger. This opening is not forced and torn by the finger, but is enlarged by the first incision of the cautery knife. The instrument having been previously tested, is introduced through the perineal opening: the index finger of the left hand feels the beak through the rectum, and irrigation through the urethra is commenced. The operator now gives the signal to turn on the current; ten seconds are allowed to heat the knife after which it is slowly unsheathed by drawing outward. From one-half to three-quarters of a minute is generally allowed to complete an incision of moderate length (1–2 cm.) and return the knife to its sheath. A longer period is required for an incision of greater length. After returning the knife to the sheath irrigation is forced through the perineal incision before withdrawing the heated instrument.

The finger of the operator is now introduced into the bladder and a careful exploration made. In cases of simple contracture a single incision of one cm. is generally sufficient to complete the operation. In cases of wide, collar-like intravesical hypertrophy, a double incision may be necessary, one on either side, or a second incision to deepen the first, the aim being to render the neck of the bladder readily accessible to the examining finger.

Care should be taken not to draw the knife too far outward into the prostatic urethra or so deep through the contracted tissue as to completely sever the internal sphincter beyond.

Following the galvano-cautery incision, a perineal drainage tube is introduced and the after-treatment is the same as after external perineal urethrotomy, the perineal tube being usually left in place one or two days according to the condition of the bladder. Daily washing of the bladder is required through the perineal tube, and after its removal, by means of a catheter introduced through the perineal opening and later through the urethra.

Cystostomy.—The establishment of a urinary fistula in the treatment of prostatic hypertrophy is merely palliative; it is a remedy to be employed only when absolute contra-indications to prostatectomy exist, or in cases in which prolonged drainage of the bladder is a necessary step in the operation of prostatectomy.

Fig. 82.—Result after Excision of Bar. (*Hugh H. Young, Annals of Surgery.*)

The aim of treatment differs under these different circumstances and the technique of the operation likewise differs. In performing a cystostomy which is merely preliminary to prostatectomy, our object is to provide free drainage of the bladder, but to provide it in such manner that the prostate can be removed easily at some future time through the fistulous tract, enlarged by incision if necessary, and with the assurance that the fistula will close promptly after the removal of the prostate.

In establishing a urinary fistula for the purpose of permanent drainage of the bladder our aim is, on the contrary, to provide the patient with a false urethra through which the urine may be evacuated at regular intervals, either voluntarily, or by means of the catheter. The ideal is attained when the canal shows little if any tendency to

close and at the same time prevents the constant leakage of urine.

For the treatment of cases in which prostatectomy is inadvisable and in which relief *per urethram* is impossible, our preference is for suprapubic cystostomy with the establishment of an artificial urethra by the method of McGuire. The reasons already given for this preference may be reiterated and enlarged upon in the present chapter.

In the first place, the results to the patient are more satisfactory than when a perineal fistula is established. When the artificial urethra remains as a permanent thing, the convenience and comfort of the patient are matters of considerable importance. Incontinence is rarely a sequel of the suprapubic operation; and when it does occur, is very readily obviated by the use of an obturator in the new channel. Where the artificial urethra is in the perineum incontinence is more likely, and when it does exist no obturator will keep urine from dribbling out; and the wearing of a urinal becomes necessary, with the retention of a tube in the perineal fistula to conduct the urine to its receptacle; since without the tube the urine would trickle down the thighs.

Urination moreover, is usually more convenient through a suprapubic than through a perineal fistula. In the former case, if the patient is not able to expel his urine in a parabolic stream, much as in the normal state, a soft-rubber catheter is very readily dropped into the bladder, and with a slight primary contraction the remainder of the urine is evacuated by syphonage. Patients with perineal fistulæ are very seldom satisfied with their method of urinating; we have heard them compare it to that of a cow.

By the suprapubic route the inflamed vesical neck is not injured, either at the time of operation, or in the subsequent treatment of the patient. Better opportunity is afforded for examination of the interior of the bladder, and for the evacuation of calculi, pus, mucus, and blood clots.

The route for drainage of the bladder and for post-operative irrigation is more direct; larger tubes are used for drainage, and as a consequence the drainage is better, the tubes are less likely to become obstructed or kinked; and convalescence is pleasanter for the patient.

The prostate is usually so large as to make access to the bladder from the perineum difficult, and to render drainage of the post-prostatic pouch by this route ineffectual. The bladder is usually dilated and carried well above the symphysis, so that it is much more readily reached by the high operation.

But there are certain cases, few in number we acknowledge, but still worthy of consideration, where bladder drainage is indicated, where it cannot be obtained satisfactorily through the urethra, and yet where the bladder is small, thick, contracted, and very difficult of access by the hypogastric route. In these patients, as a rule, the prostate is small and sclerosed, and does not obstruct urination so much by its size, as

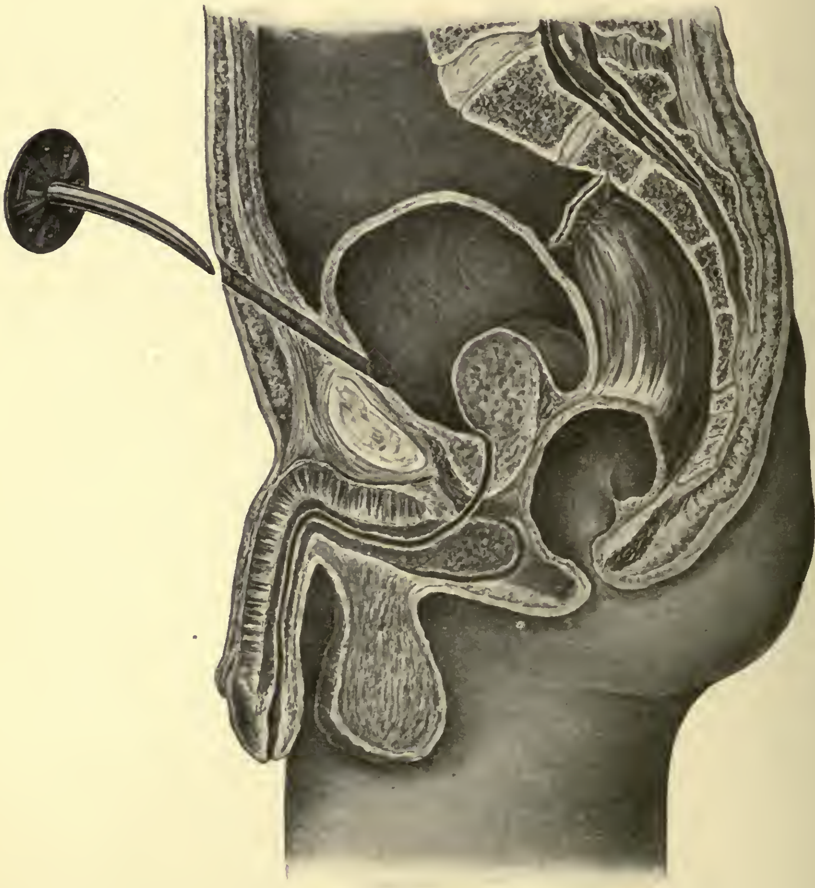

Fig. 83.—Suprapubic Fistula Established by McGuire's Method, showing the Obturator.

by rendering the neck of the bladder immobile. In such cases the advantages possessed by the perineal route are obvious.

It appears to us, then, that cystostomy for enlargement of the prostate is a very valuable operation, not lightly to be discarded. It is a step between catheterism and prostatectomy; and while it should,

on the one hand, never be undertaken without the hope of being able to cure the patient at a later time by the radical operation, yet it should always be done in such manner that, if further interference should subsequently seem inadvisable, the patient will nevertheless recover with an artificial urethra worthy of the name.

When employed only in selected cases the operation of forming an artificial urethra is attended by a very slight mortality. We are not aware that statistics of the perineal operation have been published, but the following table gives the results of McGuire's operation (in cases presumably selected) in the hands of various operators:

Operator	Cases	Deaths	Mortality, Per Cent.
Wiesinger	24	0	0.00
Bjorn Hodernus	20	0	0.00
Lagoutte	21	4	19.00
Poncet and Delore	39	2	5.12
McGuire	39	2	5.12
Horwitz	33	0	0.00
Total	176	8	4.54

Poncet and Delore called attention to the very much greater mortality which obtains among patients whose bladders are already seriously infected. Others they term the mechanical; but among the infected cases these authors record forty-two patients treated in this manner by Lagoutte, of whom fifteen died, a mortality of 35.7 per cent.; while of seventy-five such operations in their own hands, no less than twenty-nine terminated fatally, a mortality of 38.7 per cent. Watson published the results of 146 drainage operations by various surgeons, not classed as suprapubic or perineal, but probably including examples of both operations; of these, forty-nine terminated fatally, a mortality of 33.5 per cent. This high death-rate is probably to be explained in the same way as that which attends the infected cases of Poncet and Delore: because in these cases the operation is undertaken as a last resort, some of the patients being even moribund at the time, and the surgeon adopting this form of treatment as a forlorn hope, or as a means of producing euthanasia.

Technique of the Establishment of an Artificial Urethra by Suprapubic Cystostomy.—This operation may readily be performed under local anesthesia with novocaine, if desired; but where the condition of the patient does not contraindicate a general anesthetic, we prefer to use ether.

The bladder should contain from 90 to 180 cc. Where the urethra is impassable the bladder will be distended by its retained urine.

The surgeon standing on the patient's right side, an incision about five cm. long is made just above the pubis, to one side or the other of the linea alba, separating the fibres of the rectus muscle longitudinally. This lateral position of the incision decreases the chance of subsequent incontinence, as the muscular fibres keep the wound closed except when separated by the introduction of a tube.

The lower end of the incision should touch the symphysis pubis, and at the upper end the incision should grow progressively shorter as it is deepened through the abdominal walls. No vessels or nerves

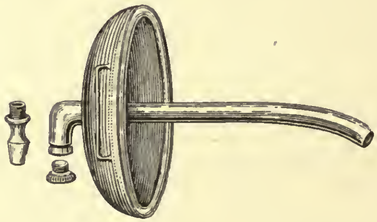

FIG. 84.—1. Stevenson's suprapubic tube. 2. Senn's sigmoid tube for a suprapubic fistula.

large enough to be named are divided, and hemorrhage is insignificant.

The space of Retzius is now opened. The fat and cellular tissue which fill it should be carefully separated in the same line as the abdominal incision, deviating neither to the right nor left. Any large veins should be avoided. If cut, however, they will cease to bleed when the bladder is opened, but can be ligated if necessary. It is usually more expeditious, as well as productive of less disturbance to the parts, to dissect through this tissue with blunt-pointed scissors. Tearing it apart with the handle of the scalpel or the fingers contuses it so that it is more liable to infection from the urine.

The bladder is readily recognized by its bluish appearance and its consistency. The reflection of peritoneum is seldom seen at all. If in the way, it is readily separated from the bladder by blunt dissection.

When the bladder is reached, a silk or silkworm-gut suture should be passed through the outer layers of its wall about eight mm. on each side of the line of the incision. These are to be used as tractors, and may be looped, or caught with hemostatic forceps. They are not designed to remain after the operation, nor to secure the bladder to the abdominal wall. Where the belly wall is thick, and the introduction of these sutures difficult, a single suture will suffice; this may then be placed in the line of the incision, at its upper limit; or a tenaculum may be used to steady the bladder, as originally recommended by McGuire.

The bladder being thus secured it should be opened at a point not above the upper margin of the pubis, the edge of the knife being turned downwards. The incision in its wall should be longitudinal, and amply large to admit the surgeon's index finger. Some of these bladders have very tough and thick walls, and the opening does not dilate as the finger is introduced. The finger should follow the knife into the bladder before much of the intravesical fluid has escaped, as it will thus be able to gain a much more accurate idea of the interior of the bladder.

Whereas in providing drainage preliminary to prostatectomy the opening into the bladder is made as near its summit as is possible, the opening in the bladder of a permanent fistula is placed close to the vesical outlet. Prompt closure of the fistula occurs after removal of the prostate when the opening is situated near to the summit of the bladder while the permanency and efficiency of a fistula are in direct proportion to the proximity of the bladder opening to the vesical outlet, and to the obliquity of the fistulous tract in its course through the abdominal wall.

Unless the prostate has been injured previously or during the operation, hemorrhage from the interior of the bladder is not apt to be severe. It is usually easily controlled by douching the bladder with hot water or with salt solution. In extreme cases the cavity of the bladder may be packed with iodoform gauze, which may be pressed firmly against any bleeding point that can be discovered.

Any calculi present should then be removed, and blood clots, inspissated mucus, etc., washed out. For such purposes it may become necessary to enlarge the wound in the wall of the bladder; but it is well to avoid this when possible.

A good-sized rubber catheter—about number 35 to 40 of the

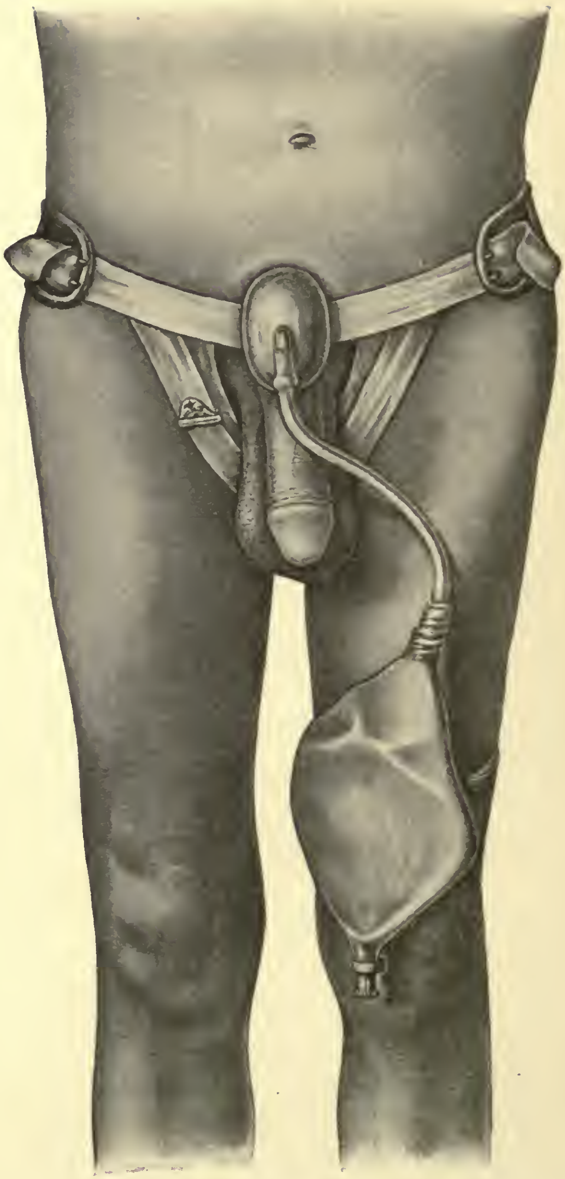

Fig. 85.—Stevenson's Suprapubic Tube in Place with Urinal Attached.—(*After DaCosta.*)

French scale—or a drainage tube, should then be inserted into the bladder, down to but not touching the post-prostatic pouch. A double tube is necessary only when vesical catarrh is pronounced. If the tube is carried down too far, its end may become hermetically sealed by the bladder contracting on it. It is therefore well to have a tube with a lateral opening, as well as to avoid inserting it too far.

The retention sutures may then be removed, and the bladder in sinking back into the pelvis will carry the vesical opening of the new urethra even lower than before. The tube may have to be inserted more deeply at this stage of the operation.

The lower angle of the incision in the anterior sheath of the rectus should then be approximated with a couple of interrupted sutures of chromicized catgut or silk; and both angles of the skin wound sutured, so as, however, to allow the catheter to emerge higher than the middle of the original incision. In his later operations McGuire employed no sutures at all, relying on careful placing of the tube to secure an artificial urethra of the desired obliquity. If the wound in the bladder has been enlarged beyond that requisite to admit the finger, it will of course be proper to apply a couple of sutures in that position. This may best be done so as to invert the bladder wall into the cavity of this viscus, thus producing a wound which is least likely to result in subsequent incontinence of urine.

The tube should be sutured to the skin on one side, to prevent it slipping in or out. A copious dressing of sterile gauze and absorbent cotton is then applied; and the tube connected by rubber tubing with a urinal beside the bed.

The urine should be kept scrupulously acid, both before and after the operation.

The patient may be allowed to sit up in bed as soon after the operation as he feels able; and may be out of bed, as a rule, on the fourth or fifth day.

If the drainage tube causes much annoyance, it may be safely removed within six or eight hours after the operation; by which time the wound will have become thoroughly "glazed." The free discharge of urine through the suprapubic opening may be relied upon to keep the wound from closing; but it is better to leave the tube in the bladder for at least forty-eight hours after the operation. If however, it has been removed earlier to relieve the patient, it can usually be replaced after the first day or two, if necessary without producing renewed irritation.

FIG. 86.—SENN'S SIGMOID CATHETER IN PLACE WITH TUBE ATTACHED FOR CONSTANT DRAINAGE INTO URINAL.—(*After DaCosta.*)

If the urethral obstruction is marked there is no likelihood of the artificial urethra closing; but where this tendency is observed, a good-sized tube should be constantly worn in the wound.

Where continuous drainage, as in cases of bad cystitis, is desired, one of the many forms of tubes with urinals attached may be employed, so that the patient will not be confined to bed. If the vesical irritability is great, and the prostate encroaches much on the cavity of the bladder,

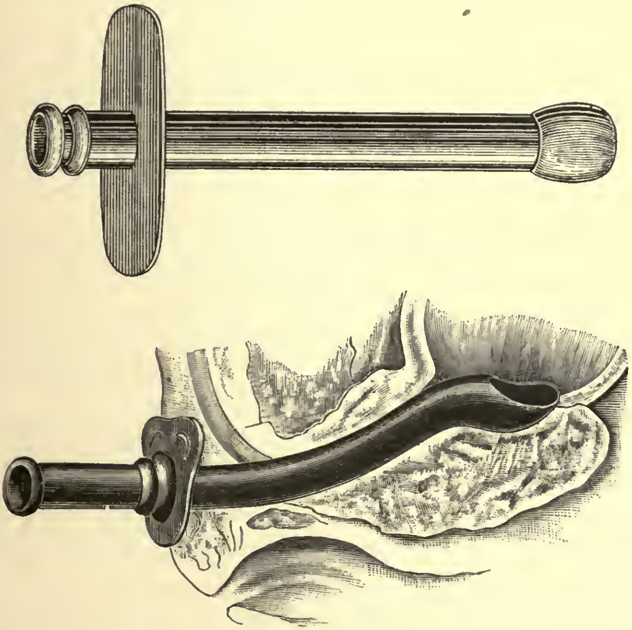

FIG. 87.—1. Owen's perineal tube. 2. Watson's perineal tube.

Senn's sigmoid drainage tube is probably the best variety. Stevenson's tube is another convenient form.

Where constant drainage is not required, but where the bladder is able to retain a certain quantity of urine and needs only occasional evacuation, McGuire's obturator may be worn in the wound; although in some cases no involuntary leakage will occur even without this appliance, except when the level of the urine within the bladder becomes higher than the external opening of the artificial urethra, or when the patient assumes the supine position. On removing the obturator the patient may be able to empty the bladder by voluntary contraction; but where the vesical atony is extreme the introduction of a catheter through the suprapubic wound will be necessary.

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CHAPTER XII

INDICATIONS FOR RADICAL TREATMENT BY SUPRAPUBIC AND BY PERINEAL PROSTATECTOMY

The palliative treatment of prostatics, which formerly engaged the attention of surgeons in almost equal degree with the radical forms of treatment, is now reserved for cases who either refuse operation, or on whom operation seems for any reason unsuited.

In this disease, as indeed in the history of many surgical conditions, operative treatment has become gradually perfected to the point where radicalism has proved itself safer than any method of palliation.

In a former edition of this work the reader was told that "when palliative treatment fails, then a radical operation is indicated." So far has surgery advanced since then that we can now say, and, in so saying express a universal surgical opinion, that in the vast majority of cases palliation should be employed only as a means of preparing the patient for prostatectomy. It is needless to recount the developmental steps in operative technique which have made prostatectomy a comparatively safe procedure; safe enough to justify it as a substitute for the former necessary evils of catheterism.

Those of us who have lived through this developmental period in the surgery of the prostate derive the keenest pleasure in advising operation in patients for whom previously we would have hesitated at the threshold of radicalism, and fearing to enter through its portals of uncertainty, would have condemned the individual to a life that is brief on the average, and certainly a miserable one, at least in part, as is the inexorable fate of these individuals.

The most recent development in the surgery of the prostate, namely the two-stage operation, is believed by some to meet the requirements of a routine procedure but to this we take exception believing that this method of treatment should be selected only in a certain class of cases. For practical purposes of treatment we divide all operable cases into three groups as follows: Group I comprises all patients in the initial stages of prostatism who present no complications necessitating pre-

liminary treatment. An individual belonging to this group presents himself with the history characteristic of a beginning adenomatous enlargement of the prostate. His symptoms are mild in type; he is suffering only slightly but realizes that something is mechanically wrong with his urinary apparatus. Patients of this type usually belong to the better classes, and the more intelligent will most likely attribute the nocturia and associated symptoms from which they suffer to a disturbance in the prostate gland. Examination of the prostate per rectum usually reveals a moderate degree of enlargement although in many instances little or no palpable change in the organ can be felt.

Having carefully examined the cardiovascular system and ascertained the kidney function, the patient is given a urinary antiseptic for a period of several days at the expiration of which time he is prepared for a cystoscopic examination and the determination of the amount of residual urine. If we are able to demonstrate a small quantity of residual urine in the absence of marked distention, inflammation or atony of the bladder wall; if the cystoscopic examination demonstrates sufficient prostatic obstruction at the vesical outlet to explain the presence of the residual urine; if the patient's vital organs are in good condition; if his kidney function is approximately normal, we deem it not only safe but wise to proceed at once with the operation of prostatectomy.

Unfortunately this group of cases is now small, but the number of prostatics who apply for operative treatment in the incipiency of their disease is increasing. The mortality among this group of patients should be almost *nil.*

Group II, which comprises the great majority of patients with prostatic hypertrophy, includes all cases in which some form of preparatory treatment is necessary if the operation is to be undertaken with safety. Cases in this group are always moderately advanced in prostatism; the effects of urinary obstruction are evident, primarily in the bladder and the upper urinary tract and secondarily, in the general effects of urinary stasis and in the systemic effects consequent upon a distressing affliction.

There is the history of suffering beginning as did that of the patients in Group I, but gradually increasing and often made worse by the instrumental attempts to relieve them. Almost all of the patients are familiar with catheterism and its effects; the majority of them have infected bladders; a considerable degree of organic change haks taen place in

the bladder walls; and the kidney function is diminished sometimes to a very low ebb.

The amount of residual urine present varies but is usually considerable. In this group of patients the treatment has been either that of neglect or of the palliative form including regular catheterization, in either instance with results that have prompted the patient to seek operative relief. Included also in this group are cases of acute retention of urine which is easily relieved by the catheter.

To attempt prostatectomy immediately in patients belonging to this group is to invite disaster. In the great majority of instances catheterism, either intermittent or continuous, together with the treatment appropriate to the complications present will result in an improvement sufficient in degree to permit of prostatectomy being attempted with every chance of success. The operation may be performed sometimes in one stage; more often it should be done in two stages.

Some few patients who at first sight belong apparently to Group II must be transferred to Group III which includes those in whom for any reason palliative treatment is contraindicated and in whom immediate relief of urinary obstruction is a necessity. This group therefore includes all patients whose condition demands removal of the prostate gland but in whom instrumentation is impossible and for this reason palliative treatment cannot be carried out and preliminary cystostomy is therefore urgently demanded.

The alternative method to cystostomy under these circumstances is tapping the bladder suprapubically, a procedure that has a very limited field of usefulness. It is indicated when the circumstances are such that an immediate suprapubic cystostomy cannot be done.

After determining the advisability of prostatectomy in any given case we must next carry out the preliminary treatment designed to get the patient in the best possible condition for operation. Having succeeded in this, we choose the method of operation best suited to the needs of the individual case. We have before us a choice of two routes of access to the prostate gland, the suprapubic and the perineal; and a number of variations in the operative procedure by either route. To determine which of these many different methods is applicable to any given case, is the task at present before us. The technique of the operations will be described in the next chapter.

Those surgeons who would confine their operative technique to either the suprapubic or the perineal route alone, and who do not admit that in some cases one route may justly be preferred to the other, so that each

is occasionally employed, appear to us to be very narrow-minded, and to be looking at the subject with prejudiced eyes. There is no more reason for one method of operating on the prostate being exclusively applicable to every case, than there is for one incision or one avenue of approach being always the only one possible in other conditions. For cleaning out the sphenoid cells, for example, it will sometimes be better to approach them from above, through the frontal sinuses, while at other times entrance will be more safely gained through the middle meatus of the nose. For draining the lesser peritoneal cavity it will at times be more advantageous to open through the left loin, while at other times the transabdominal route will be proper. For the operation of hysterectomy an abdominal operation will usually be preferred; but there are times when a vaginal excision will give better results. So with the operation of prostatectomy—the suprapubic operation is in certain cases (we think in the majority) in every way preferable to that through the perineum. No doubt a skillful surgeon will in time become able technically to remove all, or nearly all, enlarged prostates by one or the other route exclusively; but this does not prove that in a certain few cases a resort to the neglected route would not result in an easier operation, and recovery be more assured, as well. Mr. Freyer, who is inclined to the opinion that all enlarged prostates are best removed by means of the suprapubic operation which bears his name, nevertheless met with one case (Brit. Med. Journ., 1902, ii, 248; ibid., 1903, i, 901) in which he was unable to remove the prostate by this route; and the patient died of heart failure, a couple of days after the unsuccessful operation, the bladder at autopsy being found to be full of clots. Now, this result is very far from proving that the prostate in this individual patient could have been satisfactorily removed by a perineal operation, but it certainly shows that no one method can be exclusively employed, if we aim to secure the best results. And since Mr. Freyer may be supposed to possess more skill in the performance of his operation, as he certainly has had more experience than any one else, it is but reasonable to conclude that where he has failed, others will fail as well. We once saw a distinguished surgeon in a neighboring city operate by perineal prostatectomy, and although he finally did succeed in extracting the diseased organ, yet he sweat blood throughout the operation, and there was for some time grave anxiety as to the life of the patient. This surgeon was one of those who advocate the perineal operation for every case; and, as in the parallel case of Mr. Freyer, it may reasonably be supposed that those surgeons who employ

one operation exclusively will be more apt to make it succeed in difficult cases than will those who have no objection to resorting to a different method when they think the one they usually prefer will fail. There may be, indeed we have little doubt that there are, prostates which can be removed neither by one route nor the other; but there can, we think, be no question that the surgeon will do best for his patients, as well as for his own reputation, who is competent to resort to either method of treatment, as may seem indicated to him.

Speaking in favor of suprapubic prostatectomy, and referring to Watson's statement that the perineal distance is so great in one-third of the cases as to prevent the completion of the operation by the perineal route, McGill said "it is unwise to commence an operation with the probability of failing in one-third of the cases;" and "it is not advisable to limit the ability to perform an operation to gentlemen with preternaturally long fingers;" while Moore asserts that the operator's fingers grow longer as he grows in experience in the perineal operation. Both these statements, while epigrammatic, are no doubt true; but they do not invalidate the principle, already laid down, that the ability to operate by both routes is a prerequisite for the most successful treatment.

This being accepted as an axiom, it will be the surgeon's next duty to determine which cases are suited to each method of operation. It will be recollected that enlargement of the prostate occurs in two main varieties—one variety, the glandular or adenomatous overgrowth, constituting the majority of cases; while the fibrous enlargement constitutes the minority, and even at times approaches more nearly in type to prostatic atrophy, or to sclerosis of the neck of the bladder, or is at least conspicious by the relatively slight enlargement compared to the magnitude of the symptoms produced. In the former variety, as has already been pointed out, the prostate attains a greater size, and at the same time the bladder is more often dilated than contracted. In the latter variety, which seems rather intimately connected with inflammatory changes, the bladder is usually small and thickened. Hence at the onset we have the general law laid down that the hard, small fibrous prostate will usually be very difficult of access by the suprapubic route, while the adenomatous organ will at times be so bulky as to absolutely prevent its removal through the perineum, except by fragmentation. It was in a case of the former variety that Mr. Freyer found himself unable to complete his suprapubic operation, for although the gland could be satisfactorily reached, yet it could not be

removed because of its intimate adherence to the surrounding structures. As has been frequently insisted upon by Mr. Freyer, the adenomatous glands gradually "shake themselves loose" from the surrounding structures, tend to resume their bi-lobed condition, and are easily enucleated by the finger. But where the organ is fibrous, and where periprostatitis (which usually has accompanied the development of this variety) has existed, the adhesions between the prostatic capsule and its sheath are very dense, no natural line of cleavage exists, and enucelation is therefore difficult or impossible. Where prostates which approach the fibrous type (for a number are intermediate in character) are removed by enucleation, portions of the sheath, or even of the levator ani muscle, are frequently found adhering to the outer surface of the organ, it having been impossible to separate the capsule from the sheath on all sides. Yet in the fibrous prostates no subsequent increase in size is to be apprehended, and the removal of the floor of the urethra, together with as much of the lateral lobes as may be requisite, will result in sufficient lowering of the vesical outlet to accomplish the desired result; whereas a similar operation—a partial prostatectomy—in the case of an adenomatous prostate still increasing in size, would indeed give temporary relief, but might, on the other hand, be followed by continued growth in the remaining portions of the prostate, which would eventually cause renewed urinary obstruction. For such cases, therefore, complete enucleation is preferable, and that this may be more readily and satisfactorily accomplished by the suprapubic route we will presently endeavor to show.

But it is proper at this place to sound a note of conservatism. Many surgeons are rolling up long lists of successful (or unsuccessful) operations by either the suprapubic or the perineal route. But it appears to us that some such operators may be a little hasty in resorting to operative interference; and while one death from neglect to operate at the proper time is more reproach to a surgeon than several deaths which a timely operation merely failed to prevent, even though the former death never appears in his statistics; yet one death clearly caused or hastened by an ill-judged resort to operative treatment will demand an immense number of successes to blot out its remembrance. And we cannot but think that some surgeons are displaying more enthusiasm in adding many operations every year to their tale of cases, than they are in seeking the best interests of their patients.

And in connection with these thoughts, we would like to insist upon the propriety of not doing too much at any one operation. If we open

the bladder to drain it for cystitis, let us be satisfied, except in rare instances, if we secure the desired drainage, and let us not attempt to remove the prostate at the same time. If we open the bladder prepared to do a prostatectomy, and find a pedunculated outgrowth acting as a ball-valve against the vesical orifice of the urethra, let us be satisfied to remove it, and leave the remainder of the prostateal one. We do not think we can justly be accused of timidity, but we are free to confess that we are afraid to do too much to some of these decrepit old men: their tenure on life is slight, and pressing our manipulations too far may at any moment loose the silver cord, and instead of curing the patient by a brilliant operation, we shall have killed him by meddlesome, injudicious surgery.

We know quite well that in a certain number of cases removal of a pedunculated outgrowth has not prevented a return of symptoms; but, on the other hand, we are perfectly familiar with several instances where the most radical, dangerous, brilliant, and remarkable operation in the world could have had no more successful result than the simple snipping off of such a ball-valve, with scarcely more present danger to the patient than that of the anesthetic. And although Mr. Freyer has made somewhat caustic remarks upon the futility of employing anything else than total enucleation in any such cases, we have had too many cases of this kind with satisfactory results following this simple procedure to allow ourselves to be influenced even by Mr. Freyer for whose judgment and experience we have nevertheless the deepest respect.

The following case history well illustrates a cure by this procedure.

J. S., aged sixty-nine years, had been forced for seven or eight years to rise during the night to urinate. The desire was imperative, and sometimes recurred ten or twelve times during the same night. There was difficulty in starting the stream, and only a small quantity was passed at any one time. Vesical tenesmus occurred at frequent intervals, both day and night. On admission to the Lankenau Hospital, the patient was found to be plethoric; his color was sallow; his arteries were somewhat atheromatous, and their tension increased. His heart-sounds were muffled, and the second cardiac sound was accentuated throughout. His lungs were emphysematous. There was tenderness in the pubic region, and combined intravesical and rectal examination demonstrated an enlarged "median lobe" of the prostate. There were 60 cc. of residual urine. The pedunculated "median lobe" was removed by suprapubic cystostomy, by means of large forceps. Bleeding was free, but easily controlled. A rubber

tube was inserted through the suprapubic wound, which was not sutured. The patient was discharged, well, in two weeks. We have heard from him frequently since, and on recent inquiry, four years after operation, ascertained that his urination was normal in every respect.

Other similar cases are to be found in prostatic literature, but they seem to have passed from the memory of many in the profession. Burckhardt recorded the case of a patient who had suffered from urinary symptoms for five and a half years; and who for one year had had frequent attacks of retention of urine. By removal of a projecting "middle lobe" by suprapubic cystostomy, all the symptoms were relieved; and when last seen, four and a half years after the operation, the patient was in good health, and his urinary functions were normally performed. Prof. Ashhurst reported a case of similar nature, as long ago as 1882. The patient for five years had been absolutely dependent on the catheter. Finally the end of his catheter broke off and remained in the bladder. After suffering for seven weeks from this added discomfort, he applied for treatment. The foreign body was removed by median perineal cystostomy, and a pedunculated "median lobe" of the prostate was removed at the same time. On recovery the patient found to his great delight that he could pass his urine in the normal manner, and had no further use for the catheter. Harrison reported another such recovery.

To these few instances others might be added, but those given are sufficient to emphasize our point.

The *preferable route* for total enucleation of the prostate is the *suprapubic*. The prostate lies upon the triangular ligament, and above the aponeurosis of Denonvilliers; neither of these structures, so important in completing the floor of the pelvis, is divided when the prostate is lifted off them, and delivered into the cavity of the bladder. And when the prostate is adenomatous in character its enucleation is accomplished with surprising ease. Whether the prostatic urethra is removed or not, apparently makes no difference in the functional result. In many of the older perineal operations it is sacrificed in a similar manner. Indeed, Goodfellow's procedure appeared to be precisely the same as Mr. Freyer's, except that the former removed the prostate through a perineal incision.

The approach to the prostate by the suprapubic route is through structures which are less vascular, and less liable to permanent injury from the necessary manipulations. They are, moreover, not required for the function of urination. It is customary to cast in the teeth of the

suprapubic operator the fact that he makes two incisions in the bladder wall, one on its superior surface, to enter its cavity, and another in its floor to reach the prostate; and it is pointed out by perineal operators that the organ whose removal we are attempting lies entirely outside the bladder, and that by the perineal approach the bladder wall is not divided. But those surgeons who, like Goodfellow, insisted upon the propriety of entering the enucleating finger *into* the bladder cavity before beginning the enucleation, surely divided the floor of this viscus during their maneuvers; while those who, like Proust and Young, approach the prostate from its lower side, employ an extensive dissection separating the rectum from the anterior structures, and dividing the base, or working around the lower margin of the triangular ligament, and thus in either case form a wound which, as their results show, is more apt to result in a permanent fistula, while it affords no better drainage than is procured by the suprapubic operation. As was pointed out by McGill and W. G. Richardson, drainage is really better by the suprapubic wound; for it is a fact that where the bladder is drained both ways simultaneously almost all the urine escapes by the suprapubic tube, and that when both tubes are removed, the perineal tract closes first. This is, of course, where the perineal wound is a simple median urethrotomy, since, as has already been said, the wound left after a suprapubic cystostomy closes more rapidly than that resulting from the extensive perineal operations.

As to the objection that the prostate is an extravesical organ, it may be replied that it is so to the same extent as, but scarcely more so than the appendix is an extraperitoneal structure; for the enlarged prostate (and it is only that form that we are discussing now) almost invariably becomes chiefly intravesical in character, and it is therefore no more unsurgical to traverse the bladder to reach it than it is to attack the appendix by a transperitoneal route; and yet we all know that an inflamed appendix may readily, if circumstances require it, be stripped out from its peritoneal covering, leaving this in place like the empty finger of a glove, much as the perineal operators advocate scooping out submucous prostatic outgrowths from beneath the floor of the bladder without opening this organ; but nevertheless no one will prefer an extraperitoneal approach to the appendix. The enlarged prostate, in fact, is covered only by mucous membrane, or at most by attenuated muscular tissue which is as much prostatic capsule as it is bladder wall.

The mortality of Freyer's operation is higher than that shown by the statistics of the modern perineal operations; but of the cases that

recover, those that are classed as good results form a somewhat larger, and those with perfect cures a considerably larger proportion.

These facts which were originally established by statistics collected during the earlier years of the radical operation of prostatectomy have been confirmed many times by subsequent writers.

The statistics which we have collected from the more recent literature and from personal communications with confrères as well as our own experience confirms the validity of the statement that the primary mortality is slightly greater following the suprapubic operation than it is after perineal prostatectomy, but this disadvantage is more than offset by the far better results obtained in cases which recover after the suprapubic operation than after perineal prostatectomy.

This subject is discussed at some length in the chapter on prognosis to which the reader is referred.

We at one time also advocated the perineal as the preferable operation, because of the difficulties and dangers attendent upon McGill's suprapubic method; but when after seeing Mr. Freyer's excellent results, and appreciating the force of his arguments, we were emboldened to attempt a similar operation, and were greatly surprised at the simplicity of the technique, and at the pleasant convalescence of the patient. This ease of performance is another argument in favor of the suprapubic route. For although mere facility of execution by the surgeon is of itself no valid argument in favor of one operation rather than another, provided this other would secure better results and entail less danger to the patient, yet in Freyer's operation the ease consists not alone in mechanical execution, but in rapidity of performance, less distortion of neighboring parts, and less likelihood of post-operative complications; all of which are factors of much importance in old prostatics.

The perineal operation, as we have already stated, we think, is best confined to those cases where the prostate is small, fibrous, and sclerosed; where the removal of the floor of the prostatic urethra and the main part of the lateral lobes of the prostate will lower the vesical orifice sufficiently to make a clear water-way; and where there is little chance of the only portion of the prostate left (the superior commissure) subsequently enlarging and causing renewed obstruction. Where the prostate is of the character described it is usually impossible, or at all events extremely difficult, to enucleate it from within its sheath; and a more or less exact dissection is required. To accomplish this

through a suprapubic wound is nearly impossible, since the prostate is at such a distance from the surface; but when it is well drawn down into the perineum by tractors of some variety, such a dissection may usually be accomplished.

As to the preservation of the ejaculatory ducts, we regard this as entirely unnecessary. As shown in a former chapter, it is extremely improbable that semen without the admixture of prostatic fluid is fertile; and the destruction of these ducts need not of itself cause impotence. Impotence often exists before the operation; and although it has been stated that removal of the prostate may restore sexual potency, yet of this we are not very sanguine.

It will be seen from the preceding paragraphs that we prefer suprapubic prostatectomy as the radical treatment for the majority of patients. Indeed, since first adopting this method we have seen few cases in which it did not seem preferable to the perineal operation; but we recognize the fact that there are cases where the perineal is to be preferred, and when we encounter such, we do not hesitate to adopt the latter procedure.

We do not employ the various endo-urethral forms of operative treatment for the removal of median bars or the relief of contractures of the vesical neck and kindred conditions. It has always seemed to us to be the part of better judgment to open the bladder suprapubically in this class of patients and remove the obstruction under the guidance of the eye, preferably with the aid of the rongeur forceps, sometimes with the knife by a procedure similar to that recently described by Buerger, and rarely with the cautery. Occasionally a case is met with in which the prostate has been removed by the suprapubic route but in which a tab of mucosa attached to the margin of the prostatic bed is so situated as to obstruct the urethra and interfere with the emptying of the bladder. After accurate cystoscopic localization of an obstructive factor of this type it may in certain instances be removed with ease with the Young punch. Usually however we prefer to re-open the bladder in these cases, which are fortunately rare. Indeed, additional operative procedures are rarely necessary to complete the cure after a total suprapubic prostatectomy.

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CHAPTER XIII

TECHNIQUE OF OPERATIONS, INCLUDING THE PREPARATION OF THE PATIENT, WITH THE AFTER-TREATMENT

Preparation of the Patient.—The preparation of the patient is essentially the same no matter by which route—suprapubic or perineal—the prostate is to be removed.

These are not emergency operations, and the patient should be under preparation for the operation for a time sufficient to restore the vital organs to their maximum functional power. In the case of many patients the surgeon will have been in attendance for weeks or months; but even such patients require further preparation than mere surgical attention. This preparation should be both general and local. As to constitutional treatment, it is well to pay special attention to the condition of the kidneys, the heart, and the lungs.

As regards the details of pre-operative treatment—both local and general—these have been described in the discussion of renal functional tests and the palliative treatment of prostatic obstruction. We wish merely to recall to the reader's mind the urgent necessity for pre-operative treatment in all cases of prostatic hypertrophy. Treatment of the kidneys is governed by the state of renal function which is almost invariably impaired when the patients come under observation for the first time. Such treatment must differ necessarily in different cases since no two individuals present exactly the same alterations in kidney function. In one group of cases, a simple dietary and hygienic regimen is the only pre-operative treatment necessary; at the other extreme is a group in which impending uremia necessitates prolonged treatment which may or may not include preliminary cystostomy.

Selection of the time for prostatectomy even in cases in which preliminary cystostomy has been done is quite as perplexing a problem as the selection of the proper form of pre-operative treatment. Indeed, in no other surgical condition is the necessity for wide surgical experience and fine judgment greater; the most consummate technical skill is powerless to offset the evils of ill-advised surgery, and the patient whose time for operation has been chosen scientifically has a better chance for recovery in the hands of a veritable tyro in surgery than the

patient who is operated upon by a master technician before the kidney function has been restored.

For the heart it is usually well to prescribe a course of strychnine or digitalis, even if the cardiac action is not noticeably abnormal. The shock of the operation is a strain even on a well-preserved heart; but it may be much lessened by getting the heart into training previous to the operation. In our hospital experience we have found that resident physicians are only too apt to overdose the patient with strychnine after the operation, while omitting it in the preparation.

The lungs should of course be free from acute disease, such as bronchitis; and where a more or less chronic or subacute bronchitis, hypostatic congestion, asthma, or emphysema is present, special care should be exercised in the administration of the anesthetic, as well as in the prevention of chilling or exposure. For such patients we prefer nitrous-oxide oxygen to ether. Drugs directed to the condition of the lungs are usually of little use, but if the heart is treated the lungs may be benefitted indirectly.

It is not usually advisable to confine the patient to bed even on the day immediately preceding the operation, unless he is already bedridden: it is sufficient for him to regulate his life with the utmost care, confining himself to the house, and taking special precaution to break no well-established habits of life. On the morning of the operation he should, of course, remain in bed. It is well to have the services of a trained nurse for at least twenty-four hours before the operation.

The alimentary canal should be well cleaned out by a brisk cathartic given in the afternoon before the operation, and the rectum should be emptied by enema on the morning of the operation. Should the afternoon cathartic not act, it is to be repeated early in the evening or on the following morning, before the operation. If, as has been advised, the patient has been in the habit of taking a cathartic about once in a week or ten days, no difficulty will be experienced in thoroughly emptying the intestinal tract without the use of drastic purges. Indeed, the routine administration of cathartics to patients as practised in some hospitals in preparation for operation is debilitating in the extreme; the patient being in no fit condition to undergo a serious operation after a sleepless and frequently disturbed night. We think that one good free movement, which may, as a rule, be procured by one dose (15 cc.) of epsom salts or of castor oil, together with an enema on the morning of operation, will evacuate the intestinal tract quite

sufficiently; and we can see no sense in repeatedly purging patients until exhaustion is produced.

The diet for the few days preceding the operation should be light; and the supper the evening before may best be confined to fluids (milk, broth, gruel, milk-toast, etc.), and perhaps a soft-boiled or poached egg, with a little stale bread. If the laxative is taken before supper, such a meal will leave comparatively little residue, and this may be removed by an enema in the morning. Plenty of fluid may be taken up to within about six hours of the operation. This will flush out the kidneys, and help to refill the vascular system, which is always somewhat depleted if a saline purge is employed. If the operation is not to take place until afternoon, a light breakfast (broth or gruel) should be allowed, but this should be omitted when the operation is to be in the morning.

The extent of local preparation will vary somewhat with the patient. The lower class patient had best be given a warm tub bath, in the afternoon of the day before the operation; but in a patient who is in the habit of bathing himself, such active cleansing will not be required. Some patients will not become decently clean until the bath has been repeated on several successive days, and will re-acquire dirt at the least opportunity. When the demands of ordinary cleanliness are satisfied, the patient may rest until morning, when he should be shaved. It is always well to prepare for both suprapubic and perineal wounds, as some unforeseen complication may make it advisable to open in a place not anticipated. Hence the pubic and perineal hair both should be shaved; the skin of the abdomen, the groins, the genitals, the perineum, and the anterior and inner surfaces of the thighs, should all be thoroughly washed with green soap and hot water, then with seventy per cent. alcohol, and finally with corrosive sublimate solution (1:1000). A dry sterile dressing should then be applied to the abdomen and perineum, and should remain in place until removed on the operating table.

Proust laid especial emphasis on the propriety of preparing the urethra of every patient who is about to undergo a prostatectomy. He thought it extremely important to dilate the canal by the passage of sounds for some days before the operation, so as to insure the earliest possible restoration of urethral urination. But while we have no hesitation in dilating any strictures that may exist, yet we think that the routine dilatation of urethras which are apparently normal except for the prostatic obstruction is an unnecessary and therefore an undesirable performance.

We may then summarize the preparation for a prostatectomy as follows:

Preliminary treatment following the principles already stated and continued for a time sufficient to restore the vital organs to their maximum functional capacity.

Fig. 88.—Suprapubic Operation.
Skin incision exposing the sheath of the right rectus muscle close to the median line.

On the day before the operation give a bath in the afternoon; give a cathartic before supper; for supper give only semisolid food; the bowels should be opened during the late afternoon or early evening; a good night's rest should follow. Fluid may be taken as desired until six hours before the operation.

On the morning of the operation an enema is to be given. Then

shave and surgically cleanse the abdomen, perineum, etc. Apply the dressing, and wait for the operation.

Nitrous-oxide oxygen or ether is to be preferred. Chloroform is sometimes administered to patients with advanced pulmonary lesions but with relatively sound cardio-vascular systems. Anesthesia in aged individuals will often tax the skill and ability of the most expert anesthetist; this is especially true of prostatics. We never trust these cases to the relatively inexperienced Resident-Surgeon who is necessarily lacking in the skill and judgment which are so important for the successful and safe administration of anesthetics, and especially of nitrous-oxide.

We use spinal anesthesia in selected cases. In using this agent, however, it is very important not to give it where there is low blood pressure.

Suprapubic Prostatectomy.—The patient, being well covered with blankets and sterile sheets, is to have a soft-rubber catheter passed into his bladder. If such a catheter cannot be introduced the surgeon should select that instrument which from his previous experience with that patient he regards as most likely to succeed in passing the obstruction. Through this catheter the bladder is to be evacuated, and rinsed out with hot boric acid, saline solution (over 100° F.) or oxycyanid of mercury solution 1 : 10,000 two or three times, or until the fluid returns clear. About 120 cc. of this fluid should remain in the bladder, the catheter being clamped to prevent its regurgitation.

The disadvantages of distention with air have already been referred to. If a preliminary cystostomy has been done the bladder is irrigated through the drainage tube which is then removed. All of these preliminary procedures are completed before the anesthesia is begun especially if nitrous-oxide oxygen anesthesia is to be given. The patient is then raised into a moderate Trendelenburg position—about thirty degrees—and the suprapubic region uncovered. The surgeon, standing on the right of the patient, then makes his suprapubic incision, which in thin patients need not exceed six cm. in length; but must be increased up to a limit of perhaps ten to twelve cm. where the abdominal wall is extremely fat. This incision, which we make to one side or other of the linea alba, usually to the right side, exposes the sheath of the rectus muscle. Its lower end should be at the symphysis pubis, neither above nor below. If annoying bleeding occurs from veins or arterioles, these should be clamped; the hemostatic forceps may usually be removed as soon as the bladder is exposed, and will therefore not be in the way in the subsequent steps of the operation. Vessels of any size,

which are rarely met with near the middle line of the abdomen, had best be ligated at once.

The sheath of the rectus muscle is then opened, and its fibres separated, longitudinally with the handle of the scalpel, from their pubic attachment below, up to but not quite as far as the skin incision extends. We regard this lateral incision as of distinct advantage in decreasing

FIG. 89.—SUPRAPUBIC OPERATION.
Separation of the fibres of the rectus muscle with the handle of the scalpel.

the chances of the formation of a permanent fistula. The wound thus made tends to close spontaneously as soon as the drainage-tube is removed; and although post-operative hernia in this situation is unusual, it is by no means unknown.

The transversalis fascia and preperitoneal fat are then divided with the scissors in the line of the skin incision; any decrease in the length

of the incision should be made at the expense of the upper end of the wound; that is to say, the surgeon should aim to work down on the anterior wall of the bladder, not up towards its peritoneal surface. The layer of vesical fat will next be exposed, lying below the prevesical reflection of the peritoneum. The surgeon may then either pass the

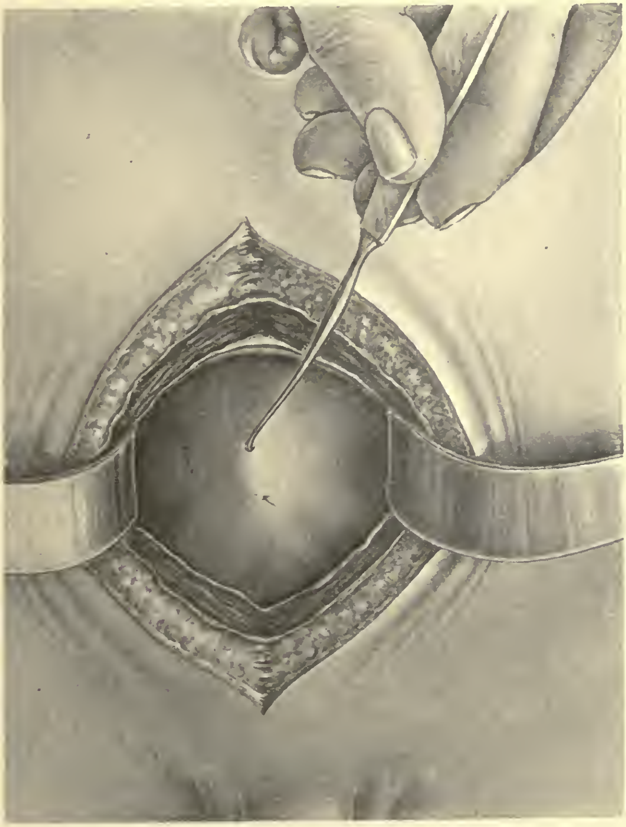

Fig. 90.—Suprapubic Operation.

The bladder has been exposed, below the prevesical fold of peritoneum, which can be seen across the upper angle of the wound. A tenaculum steadies the bladder, preparatory to its being opened.

fingers of his left hand down behind the pubis to the pubo-prostatic ligaments, and draw this layer of fat bodily up towards the abdominal end of the wound, or snip through it in the line of the original incision, with his blunt-pointed scissors. We prefer the latter course. Retractors may be applied to each side of the wound, and aid in keeping the structures to be divided fairly taut. Any hemostatic forceps which were

used to clamp bleeding points in the abdominal wall may now be removed, since it will be found that such vessels have ceased to bleed.

The large veins in the prevesical fat should be avoided if possible. If the surgeon divides any, it is well to ligate them at once. If possible, they should be ligated in two places before being cut, the division between two ligatures maintaining the wound dry, and enabling the surgeon to see clearly the field of operation.

The edges of the wound having been retracted, a small piece of moist gauze is placed above the bladder and with a third retractor the peritoneum is pulled upward thus making exposure of the bladder, division of the prevesical fat, and opening the bladder a simpler procedure.

The prevesical fold of peritoneum may not be seen in these operations, the Trendelenburg position, even without the distention of the bladder, allowing it to recede above the upper limits of the wound. If it is seen, it is, as a rule, easily recognized, both by the typical appearance of peritoneum seen elsewhere, and by the fact of its being a transverse fold; and it is easily detached from the bladder by blunt dissection. Should it unfortunately be opened, it should at once be sutured.

The bladder is recognized by its blue appearance and its consistency. If any doubt exists as to its identity, it will be sufficiently manifested by injecting more fluid through the catheter. There are often large and turgid veins on its surface.

When the bladder is thus exposed, two retention sutures may be passed through its outer coats, about twelve to eighteen mm. apart, equidistant from the proposed line of incision, and in its upper third. We formerly passed these sutures through the whole thickness of the abdominal walls as well, and let them remain at the conclusion of the operation, thinking thus to lessen the danger of extravasation into the space of Retzius; but we think the likelihood of this danger is overestimated, and we have had more fear of causing an injurious anteflexion of the bladder; so that we no longer intend these for permanent sutures, but merely to act as guys during the enucleation of the prostate. If it is difficult to pass these sutures, on account of the depth of the wound, one may be made to suffice by placing it in the line of the incision, at the upper angle of the wound. Indeed, we now find it quite sufficient to steady the bladder with a tenaculum until the finger reaches the prostate and then to remove the tenaculum and let the bladder fall back into the pelvis during the enucleation.

The bladder, being thus securely fixed in the wound, is to be opened by an incision made towards the pubic symphysis, and extending below

it. This incision in the bladder walls should never be made upwards, as not only might the peritoneum be opened, but a coil of intestine wounded as well. It is inadvisable to make an incision of more than 25 to 40 mm. in length in the bladder wall, and the left index finger of the surgeon should follow the knife in, so as to palpate the inner surface of the bladder, the prostate, and the urethra, before all the fluid has escaped. A much more accurate idea of the relations of the various parts is attained when the bladder is distended.

The table may now be replaced in the horizontal position.

The finger should first seek to recognize the position of the urethra with its contained catheter. The outlines of the prostate can next be determined, the presence of calculi detected, and plans made for the further continuance of the operation. Any calculi present should first be removed, with forceps or scoop. If no guy sutures have been retained in the bladder it is best not to remove the finger from its interior until the completion of the operation, as its re-introduction may be difficult if the abdominal wound is deep. If a large calculus is found, the incision in the vesical wall may need to be enlarged before the stone can be safely removed; but with skill even large stones may be removed through an incision of little more than 25 mm. In very many cases retractors must be employed to draw apart the sides of the abdominal wound and the bladder wall before the prostate can be satisfactorily exposed. At times two other retractors may be used to advantage, increasing the field of operation in its longitudinal diameter.

If a pedunculated prostatic outgrowth acting as a ball-valve against the vesical orifice of the urethra is found, it should be twisted off with the fingers, or its pedicle should be cut through with scissors or bladder forceps. If no other urethral obstruction exists,—a fact which can readily be determined by partially withdrawing and re-inserting the catheter,—the operation may now be terminated, and the bulk of the prostate be left untouched. Often, however, there will be found similar prostatic tumors projecting into and obstructing the urethra, which are not evident from the cavity of the bladder; hence the great importance of making sure of the patulous condition of the urethra before deciding to conclude the operation by a partial prostatectomy. This is a point which was much insisted upon by Belfield, and is probably the explanation of the failure of so many of the early suprapubic prostatectomies to effect a permanent cure.

At the present time but few operators would be content to remove a pedunculated nodule or lobe and leave the prostate undisturbed. But

we insist, there are some few cases in which this condition exists, in which a cure can be effected without removal of the prostate. Doubtless some of these tumors arise from the subcervical group of glands and are, therefore extra-prostatic in origin, which fact explains the success following their removal. We are in the habit of making a careful bimanual examination of the prostate in these cases, with the index

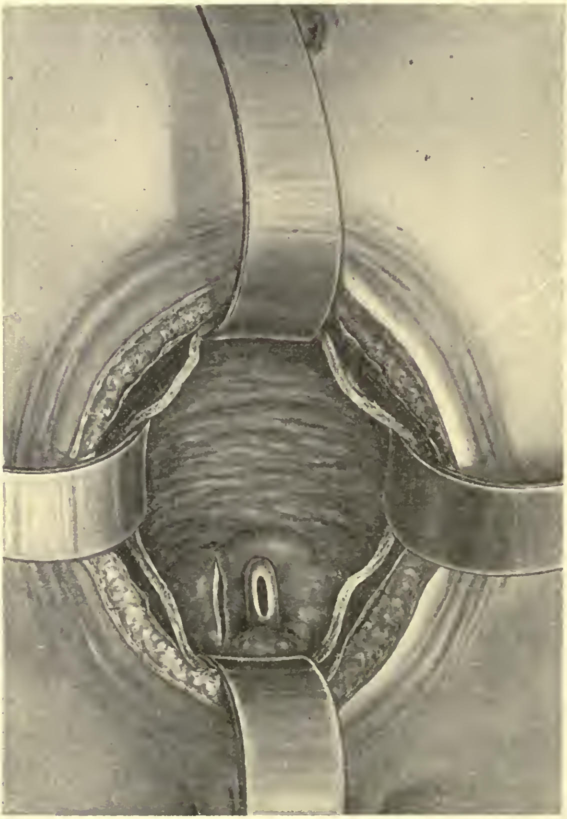

Fig. 91.—Suprapubic Operation.

The bladder has been opened, and by the use of retractors the field of operation is exposed sufficiently to show the enlarged prostate with the end of the catheter projecting from the vesical orifice of the urethra. An incision has been made in the vesical mucous membrane over the right lobe of the prostate, down to its capsuls.

finger of one hand in the prostatic urethra and the index finger of the other hand in the rectum. By this means any irregularities in the shape or increase in size of the gland may be demonstrated, and if a beginning hypertrophy, however early, is found, the prostate is removed.

If no such pedunculated growth exists, or if a complete prosta-

tectomy is indicated, the enucleation of the prostate is begun. This may be accomplished in one of several ways; no one method is applicable to every case. In the majority of instances we find the intraurethral, or as it is sometimes called, extravesical method, preferable. Squier, who first advocated this procedure, recommends that the roof of the urethra be broken through and that the enlarged lateral lobes be removed separately through this single opening.

We have found it advantageous to begin the enucleation by breaking through the mucosa on the side wall of the urethra usually over the most prominent part of the prostate and on a plane posterior to the colliculus.

With the manipulation necessary to free the lateral lobe this tear in the mucous membrane is enlarged, but it usually extends circumferentially and proximal to the colliculus so that the anterior portion of the prostatic urethra, including the colliculus and the terminals of the ejaculatory ducts, is not destroyed. Nature aids us in preserving these structures, as Squier has shown, because they are but loosely attached to the prostate.

If the finger is now made to cross behind the urethra to reach the opposite lobe after freeing its fellow, there is little danger of injury to the floor of the urethra especially when the lateral lobes are easily enucleable, and the enucleation of these lobes is done separately. This is often unavoidable, however, because of the presence of nodules beneath the urethra. These may take origin from the middle lobe tubules or from the lateral lobes; in either event destruction of the proximal part of the urethra occurs during their removal. Care should be taken to remove only that part of the urethra proximal to the colliculus.

In cases where there is bilateral and symmetrical enlargement of the lateral lobes in the absence of nodules beneath the floor of the urethra, the hypertrophied lobes may be removed separately through a tear in the mucosa of the roof of the urethra after the method of Squier.

Ordinarily the details of the enucleation as practised in our clinic are as follows: the index finger is introduced into the prostatic urethra which is thus dilated; care being taken not to overstretch the parts. One or two fingers of the opposite hand are inserted into the rectum for the purpose of steadying the prostate. The mucous membrane on the lateral wall of the urethra covering the most prominent part of the enlarged prostate is torn through on a plane posterior to the colliculus.

The finger soon finds the line of cleavage and this is followed upward and forward thus freeing the apex of the lobe. Next the finger is

swung around the upper and outer surfaces. Having completed this the finger is again passed forward and an attempt is made to free, or, as Squier expresses it, "hook back" the lobe into the bladder. Succeeding in this, it only remains to free it from its attachment to the vesical mucosa; this is usually not difficult.

The finger is re-inserted into the urethra and into the cavity whence the lobe came; it is then passed across the roof of the urethra, if we may be permitted to so express it, and the remaining lateral lobe is enucleated in exactly the same manner.

In many cases it is found after freeing the first lobe that a sub-urethral portion of it, or in some instances, an attached median lobe enlargement prevents the delivery of the otherwise freed portion into the bladder cavity. It is better in these circumstances to remove the gland *en masse* at the same time making every attempt to spare the floor of the urethra.

Having failed to deliver the lateral lobe into the bladder cavity, the finger is swung around and behind the median portion. This brings us to the posterior surface of the opposite lateral lobe. This is dissected free, exactly as was its fellow on the opposite side, except that the steps of the procedure are reversed—the posterior and outer surfaces being freed first.

The gland may then be hooked back into the bladder cavity—not as separate lobes but as a single trilobed body. The final step in its removal is completed when adhesions to the vesical mucous membrane are divided.

With proper care, the anterior part of the prostatic urethra need not be destroyed.

In enucleating the prostate from the vesical side, an incision long enough to admit the end of the index finger, should be made over the more prominent of the two lateral lobes. This incision should run parallel with the urethra, and is usually most conveniently made with a pair of scissors; we have, however, on numerous occasions, simply scratched through the vesical mucous membrane with the finger-nail. The surgeon then introduces the middle and index fingers of his right hand, gloved, into the patient's rectum, passing his arm beneath the flexed thigh; and placing his thumb against the perineum, makes counterpressure on the prostate, and raises it up towards the enucleating finger. The larger and more adenomatous the prostate, the easier it is for the surgeon to find the natural line of cleavage which exists between the prostatic capsule and its sheath. It is not safe to go too wide of the

prostate in the endeavor to remove it all. All of it will be removed, except perhaps here and there a flake off the outer surface of its capsule, by clinging close to the adenomatous organ rather than by going off on voyages of discovery into the sheath. In other words, the prostate is to be removed from its sheath, not the sheath from the prostate.

The finger should first pass to the outer side of the lateral lobe first attacked. In this situation the attachment of the prostate to its sheath is least dense. Then the finger should cautiously but not timidly work down and under the lateral lobe, towards the neighborhood of the posterior commissure and the ejaculatory ducts. Next the posterior and inferior surfaces are separated from the sheath; and, finally, when the lobe is pretty well outlined, the finger may pass along the lateral and inferior surfaces to the apex, and free it from the triangular ligament.

At times the lateral lobe first attacked may come away alone, leaving the urethra still attached to the other lateral lobe. More often in our experience the original incision through the vesical mucous membrane has torn larger during this enucleation, and the vesical orifice of the urethra has become entirely detached by the extension of the tear across the trigone of the bladder. Then the enucleating finger will pass across to the second lobe, often as it does so tearing loose the ejaculatory ducts from their union with the urethra, and finally, having completed the enucleation of this second lobe, will find the prostate fully detached from all its surrounding structures except where the urethra annexes it to the triangular ligament.

At this stage of the operation either one of two things happens—the urethra slips out from the centre of the prostate, remaining still attached to the triangular ligament, and hanging loose like the empty finger of a glove (with its end cut off) in the cavity from which the prostate has been enucleated; or, which we think is more frequently the case, the urethra tears off at the triangular ligament, and its prostatic portion is removed entire in the centre of the prostate. We do not see how it is possible, and know it has never been so for us, to leave the prostatic urethra, with the attached ejaculatory ducts in place, annexed at both ends—anteriorly to the triangular ligament, posteriorly to the bladder wall. We have been able to remove the entire prostate, including of course its urethra, through the one original incision made through the vesical mucous membrane; but where the organ is very large this cannot be satisfactorily done, and a second incision, comparable to the first, must be made over the other lateral lobe. If the

anterior commissure of the gland gives way during these manipulations it is theoretically possible to swing the whole prostate (which is then merely an organ with the urethra lying in a groove on its upper surface) across beneath the urethra, and to deliver it entire through one or other

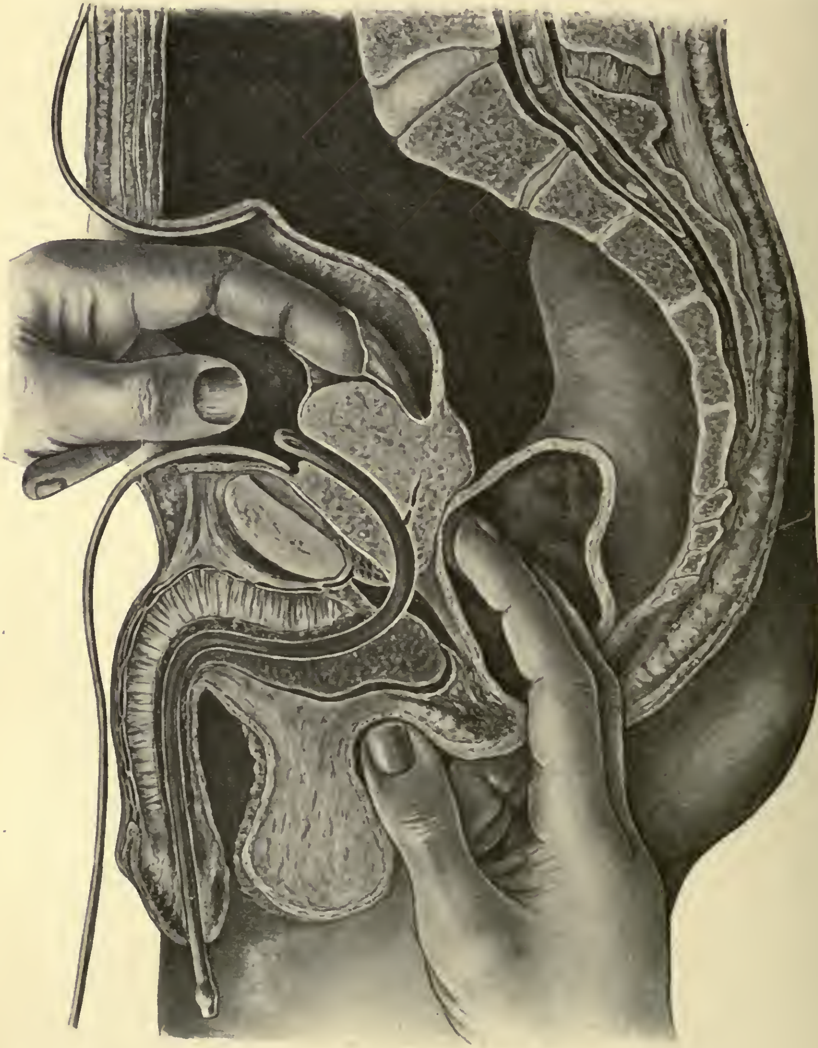

Fig. 92.—Suprapubic Operation.
Sagittal section of pelvis, showing finger enucleating the prostate from its sheath, as counter-pressure is made by the other hand in the rectum and on the perineum.

of the incisions in the mucous membrane of the bladder; but even thus, we cannot see how the attachment of the ejaculatory ducts can be preserved, in the Freyer operation, though it is theoretically possible for the prostatic urethra to remain intact, traversing the cavity from

which the prostate has been removed, much as a resistant artery traverses a phthisical cavity.

The condition of the parts which is probably the most usual is shown in Figure 93 taken from one of Freyer's patients who died two hours after the operation. Here two tongue-like processes can be seen, representing the remains of the urethra, extending downwards from the vesical mucous membrane, and upward from the triangular ligament; while between and below these can be seen the ejaculatory ducts, torn loose from all connection with the urethral floor.

The technique of enucleating the prostate just described is essentially that of Freyer; it is the method which we have employed for many years but which has lately been discarded largely for the intra-urethral method of Squier. The latter is described on page 300 *et seq*. Our technique isotherwise as just described.

When the prostate has thus been delivered into the interior of the bladder, the tissues left between the rectal and vesical hands are felt to be very thin, and no trace of remaining prostatic substance can be detected. The hand is then withdrawn from the rectum, the glove removed, and the prostate extracted from the bladder with the fingers or with suitable forceps. The more adenomatous the postrate, the more compressible it will be, and the vesical incision should not be enlarged until attempts to remove the prostate have failed.

The cavity from which the prostate was enucleated will now be found to have become amazingly reduced in size, both by active contraction, and by pressure from the surrounding structures. Bleeding may be free, but is usually only moderate in amount, and readily controlled by the hot douche, which is to be freely applied through the suprapubic wound.

Should this fail to control the hemorrhage another plan must be tried. Often by gauze pressure well directed against the oozing area the bleeding may be checked. But if the hemorrhage persists, or in case of secondary hemorrhage, continuous pressure must be applied. It has been advised to apply this in the following way: a number of layers of gauze, of suitable size, are stitched together at their centre; the end of the suture is left long, and is attached to the intravesical end of the catheter which has been lying in the urethra throughout the operation, or which is to be introduced if not already in place. By withdrawing this catheter, the thread will follow, and will press the attached gauze firmly against the vesical orifice of the urethra. Care should be taken that this gauze does not occlude the ureteral orifices.

This method of hemostasis has always seemed to us to be objectionable. When the gauze becomes soaked through with urine there is risk of its acting merely as a sponge, and thus allowing the blood to ooze through its meshes. A safer plan, we think, is to pack with gauze the cavity from which the prostate has been enucleated, and then to suture

Fig. 93.—Appearance of Parts After the Completion of Freyer's Operation, Showing the Remnants of the Prostatic Urethra, Attached Below to the Triangular Ligament and Above to the Bladder. Between the Divided Ends of the Urethra are seen the Remains of the Ejaculatory Ducts.—(*Walker.*)

over the packing the mucous membrane forming the roof of the cavity from which the prostate has been removed, of course leaving an end of the gauze long, to come out through the suprapubic wound, and facilitate its removal. The suture material should be catgut, and the pack-

ing may remain in place until it became loosened by the absorption of the catgut—usually in from four to five days. Of course, if this method were adopted for the control of secondary hemorrhage, the patient would have to be anesthetized and the suprapubic wound enlarged. For secondary oozing which is not marked irrigation with hot water will usually be found an efficient hemostatic; or a solution of adrenalin chloride (1:10,000) may be used. It is certainly well to try the effect of milder measures first, and not resort to packing injudiciously. Of recent years it has been our practise to place a purse-string suture of catgut in the torn edge of the vesical mucosa. With this suture in place the prostatic bed is packed with gauze in the manner just described. The suture is then tied, thus drawing the edges of the mucosa together over the packing and holding it securely in place. This has proved a most efficient method of controlling bleeding after prostatectomy.

Since adopting the intra-urethral method of enucleating the prostate we have had less troublesome bleeding. In the cases where packing has become necessary the enucleation of the prostate has been beset with difficulties. These have been cases with small fibrotic prostates during the removal of which lacerations of the mucosa in the region of the vesical outlet have occurred. Packing after the manner just described is particularly applicable to these cases.

When the urethral mucosa remains practically intact the arrest of hemorrhage, which is rarely called for in these circumstances, can be accomplished by packing gauze into the remaining funnel of mucous membrane in quite the same manner as one might fill the finger of a glove. The pressure thus exerted on the cavities whence the lobes of the prostate came, is sufficient to stop all dangerous bleeding; sutures are unnecessary.

Of the many methods proposed for controlling hemorrhage after suprapubic prostatectomy in addition to the one just described, two alone are worthy of consideration.

One of these, advocated by Judd, entails careful hemostasis by suture and ligature with primary closure of the bladder. This method was advocated, and practised for a time, by the late John B. Murphy of Chicago but was later discarded by him. We likewise discarded this method after experiencing the necessity of re-operation to evacuate a bladder filled with blood clots. The advantages in time and comfort for the patient to be gained by primary closure of the bladder are more than offset, in our judgment, by the dangers attending this procedure.

Hagner is sponsor for the other method, namely, the control of bleeding by pressure exerted through the medium of a distensible rubber bag.

The Hagner bag has been modified by Pilcher to the extent that a catheter attachment is provided.

This method is especially applicable to cases in which the two-stage operation has been performed, and in which, for any reason, haste is vitally necessary for the control of bleeding after the removal of the prostate. We do not advocate this method for cases in which it is permissible to enlarge the wound and control the bleeding by gauze pressure and suture.

As soon as the prostate is extracted from the interior of the bladder, the urethral catheter, if not previously withdrawn, is to be removed; and a long rubber tube of large calibre—*eight to ten mm.*—passed into the bladder through the suprapubic wound. This tube should be open not only at the end, but should be provided with large eyes on its sides near the vesical end; since, should the bladder wall come in contact with the distal opening, all drainage would be effectually prevented. To further obviate the likelihood of any such obstruction We do not pass the tube to the bottom of the post-prostatic pouch, nor do we, in any circumstances, dismiss the patient from the table until it is evident that the tube is clear of all clots and other obstructions, and the urine or intravesical fluid can be seen distilling from its further end drop by drop.

The tube should project from the bladder cavity for a distance of several centimetres; it should be fitted with an elbowed glass tube, to which in turn is attached rubber tubing leading to a urinal which is attached to the side of the bed.

The anesthetic may be stopped as soon as the irrigation of the bladder is commenced; and by the time the patient is in his bed he should be fairly conscious of his surroundings.

The suprapubic tube is held in place by a stitch through the skin; and the angles of the wound, when this is large, may be sutured, but if the urine is foul no sutures at all should be employed; but as the parietal peritoneum has a tendency at times to prolapse into the upper angle of the wound, one suture in this situation may be necessary. Separate catgut sutures should be used for the sheath of the rectus muscle and for the skin. The dressing, of sterile gauze, cut so as to fit around the tube, and each piece overlying that beneath in an imbricated manner, should be copious, and may be reinforced with absorbent cotton. Thus what-

ever urine is not carried off by the tube, but leaks out along its sides, will be quickly absorbed in the dressings, and will not trickle over the patient's buttocks and clothing.

The further end of the tube must be connected with a suitable receptacle below the level of the patient's bladder, so that the syphonage

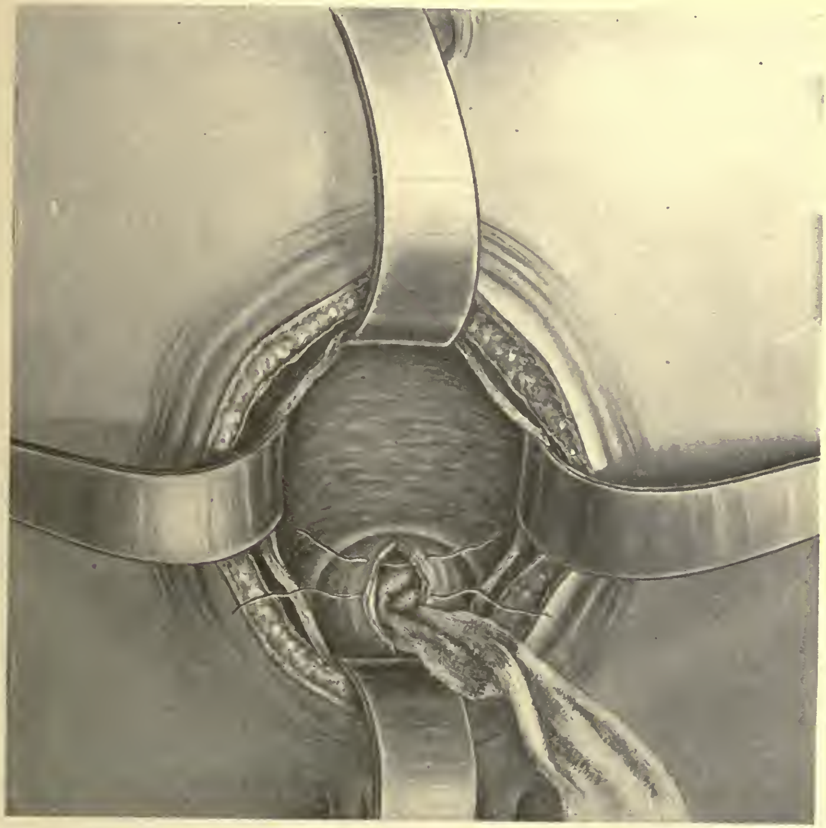

FIG. 94.—SUPRAPUBIC OPERATION.

In case of persistent hemorrhage the cavity from which the prostate has been enucleated is packed with gauze, and the margins of the vesical mucous membrane sutured over the packing with catgut.

may be continuous. If this detail is attended to there will be no necessity for the employment of a vacuum pump, as described by W. G. Richardson or the more recently described vacuum bottle of E. G. Davis. The urinal into which this suprapubic tube drains should be partly filled with some antiseptic or deodorant solution, sufficient in depth to cover

the end of the tube; and in calculating the amount of urine excreted the quantity of fluid already in the urinal must be subtracted.

The suprapubic dressing may be renewed as often as it becomes saturated. As a rule, twice daily is quite frequently enough.

Should there be much shock after the operation, suitable stimulation must be administered; but it is of more importance to prevent shock, and for this purpose nothing is so efficacious as external heat. The patient may be surrounded with hot-water bags throughout the operation in many cases with the greatest advantage, or, better still, be placed on a hot-water bed.

On the day following the operation, and once each subsequent day, the bladder may be douched through the suprapubic wound. This should not be done routinely however; if the drainage is perfectly satisfactory and the bladder cavity is free from large blood clots there are no indications for douching in the average case. Bladder irrigations are useful, however, in patients with foul cystitis.

We do not retain a catheter in the urethra, nor do we pass one to irrigate the bladder after the operation until this can no longer be accomplished through the suprapubic wound. But if an ammoniacal state of the urine develops we think great advantage is to be derived from douching the bladder through the urethra, the fluid draining off by the suprapubic wound.

For the purpose of intravesical douching in these cases it is usually quite sufficient to introduce the nozzle of the syringe into the urinary meatus, there being no necessity to pass a catheter into the bladder, since the passive resistance of the urethra can readily be overcome by fluid pressure. The suprapubic tube may usually be removed on the second day after the operation, and the patient encouraged to pass his urine in the natural way; but there is no objection to leaving the tube in place for five or six days if such a course should seem desirable. Voluntary micturition commonly returns early after this operation; and, as there is no fear of a sinus persisting the patient may be propped up in bed on the fourth or fifth day, and be allowed to sit in a chair at the end of a week or ten days if his general health permits. Indeed, as soon as the patient feels able to be out of bed, no matter how few days have elapsed since the operation, we think he should be allowed to be up.

Unless something should indicate the existence of urethral obstruction, we are not in the habit of passing instruments by this route so long as the suprapubic wound remains available for the daily irrigation of the bladder. Should, however, this fail to show any signs of closing

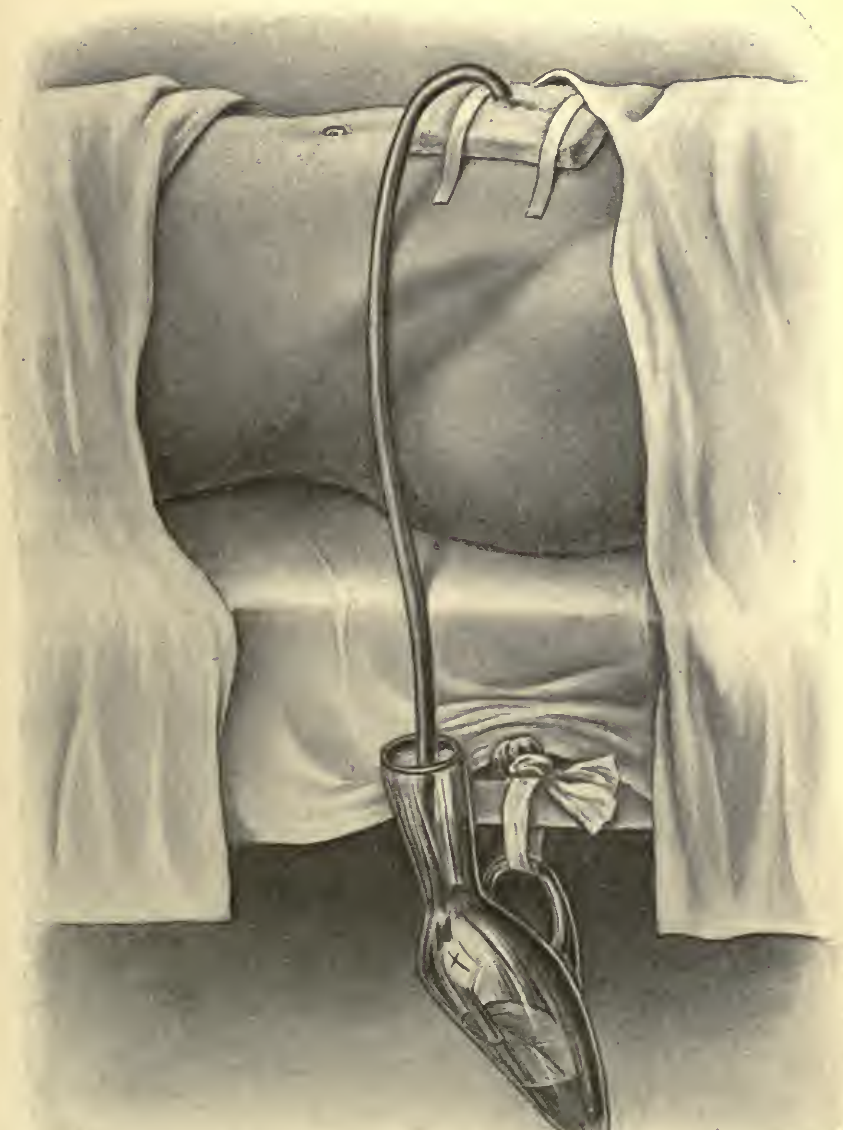

FIG. 95.—SUPRAPUBIC OPERATION.
Drainage-tube and dressing in place.

in the second week, we think it proper to sound the urethra, so as to ensure against the formation of strictures. We do not regard it as at all impossible for strictures to form as a result of the removal of the prostatic urethra; but we think the injudicious resort to instrumentation might very well render their formation more probable. When, however, the suprapubic wound has closed, which it commonly does in the third or fourth week, we consider it safe to irrigate the bladder through the urethra; and this, we think, should be done at least once a week for some months after the operation, unless the urine sooner becomes normal. In any case, the regular passage of a full-sized sound once a week for some months after the operation can be productive of no harm, and should, we think, be advocated in most cases, especially where a tampon has been employed for the control of hemorrhage.

Some surgeons have found that the suprapubic wound is apt to re-open once or twice before finally healing; but this has not been our experience except in the rarest instances.

Secondary hemorrhage and the means of controlling it have already been referred to; but we think it important to call attention to looseness of the bowels as a cause of this complication. Every time the bowels are opened the granulating wound is disturbed, and the liability to bleeding increased. Hence diarrhea should be avoided, and where slight oozing persists it may be well to try the effect of opium or paregoric before more strenuous measures are resorted to. Secondary hemorrhage has been known to occur after the passage of the rectal tube. Care must be taken, therefore, in giving enteroclysis lest the insertion of the tube cause injury to the prostatic bed.

The patient's usual diet and mode of life may be resumed as rapidly as his convalescence will permit; but he should pay particular attention to the state of his kidneys and urine for many months after the operation. He should be encouraged to drink all the water possible from the instant his stomach becomes retentive after recovery from the anesthetic; this is the surest method of preventing uremic conditions. The appearance of hiccough and nausea following the recovery from anesthesia, particularly if a small amount of urine is being excreted, is indicative of a mild degree of uremia, and should be promptly met by medical measures. It is not our practice to resort at once to agents such as calomel, sparteine, caffeine, etc., after operation, but to immediately wash out the stomach with the stomach-tube, this being a far more effective remedy for hiccough than any antispasmodic drug; we then introduce into the stomach 45 to 60 cc. of Glauber's salt in concentrated

solution. Where the stomach is empty the solution soon finds its way into the small intestine, and in a short time bowel action is obtained. We have found this of more service than any other agent. Should further treatment be required, however, rectal, subcutaneous, or intravenous infusions of decinormal saline solution should be employed, and other appropriate treatment should be instituted, as already indicated.

SUPRAPUBIC PROSTATECTOMY—THE TWO-STAGE OPERATION

In speaking of the methods of choice in the treatment of the several groups into which prostatics may be more or less definitely separated on pathological grounds, we defined very clearly our belief regarding the two-stage operation.

This discussion needs no reiteration and we will proceed therefore, with descriptions of the most satisfactory methods of performing cystostomy preliminary to removal of the prostate.

In performing a cystostomy for preliminary drainage of the bladder the technique which we employ differs but little from that followed in opening the bladder in the one-stage operation, except insofar as the length of the incision is concerned, and the degree of exposure of the space of Retzius and of the anterior bladder wall.

Our aim in doing a preliminary cystostomy is to open the bladder as near to its summit as possible, to make the opening of sufficient size to permit of digital exploration of the bladder cavity and of the removal of any calculi that may be present, to provide adequate drainage, and, finally, to perform the operation in such manner that the tissues surrounding the incision will be disturbed as little as is consistent with the proper performance of the operation.

To determine the proper position for the drainage tube it is advisable to locate the line of reflection of the peritoneum from the bladder wall. In some cases it will be found necessary after opening into the bladder cavity either to enlarge the opening in an upward direction or to make an entirely new opening at a higher level so that the drainage tube emerges from the bladder near its summit. A cystostomy opening for permanent drainage is placed near the bladder outlet; here our purpose is quite the contrary since the more distant the opening is from the neck of the bladder the more quickly will the fistula close after the removal of the prostate.

For preliminary drainage we prefer a tube of large diameter, as large as, or even larger than the one used for drainage after prostatectomy. In some few cases a small dePezzer catheter after the method of Pilcher is desirable. This is done especially in cases of acute retention with enormously distended bladders. If immediate operation becomes necessary owing to the impossibility of catheterization, the introduction of a dePezzer catheter into the bladder through a suprapubic wound under local anesthesia is a matter of commendable simplicity. The operation may be performed quickly; it provides adequate drainage to relieve the dangerous back pressure on the kidneys, and it provides an easy and efficient means of intermittent relief of the abnormally high intravesical pressure. This method we believe is superior to the trocar and cannula method of Lower which suggests itself as particularly applicable to this group of cases. The after-results, however, leave something to be desired as far as the ease of subsequent removal of the prostate is concerned.

FIRST STAGE—PRELIMINARY CYSTOSTOMY

The average patient who is subjected to the two-stage operation in our clinic is a poor operative risk; this is true certainly at the time of the preliminary drainage operation. For this reason it is advisable to use local anesthesia in many instances. We prefer, however, nitrous oxide, oxygen or ether anesthesia when there are no special contra-indications to their use. We have practically discarded spinal analgesia.

For local anesthesia we use novocaine in solutions of 1/200 or 1/100 strength, the stronger solution being used in the skin and bladder wall.

In the absence of very definite contra-indications to their administration, morphine sulphate gr. 1/4 and atropine sulphate gr. 1/100 are given hypodermatically one-half hour before operation. Scopolamin gr. 1/100 and morphine gr. 1/6 may be given before operation with gratifying results. We have seen no harm result from the judicious use of these drugs in combination.

The patient is prepared for operation in the usual manner, a catheter is introduced into the bladder and the latter distended with a solution of warm boric acid, oxycanid of mercury (1–10,000) or other antiseptic. The technique is essentially the same whether the cystostomy is performed under local or general anesthesia except as regards the introduction of the local anesthetic into the tissues. We will describe the use of local anesthesia in some detail.

The instrument tray should contain, in addition to the usual instruments, a number of syringes, fitted with sharp needles of small calibre and filled with novocain solution of the desired strength.

The injection of novocain solution ($\frac{1}{100}$) is begun at a point about ten centimetres distant from the symphysis pubis and about one cm. to midline. Beginning at this point the injections are continued in a straight line downward to the top of the pubic bone. The skin and subcutaneous tissues are included in this primary line of analgesia. An incison is then made down to the rectus sheath. The latter is infiltrated and is then incised in line with the skin incision. The muscle tissues and underlying transversalis fascia are injected with a weaker solution of novocain, the muscle fibres are then separated and the fascia is incised. The prevesical tissues are now exposed. These are separated by blunt dissection, and only insofar as is necessary to expose the line of peritoneal reflection from the bladder, and enough of the latter to permit cystostomy. The cystostomy opening is made of sufficient size to admit the introduction of the drainage tube. The space of Retzius is exposed during these manipulations but its contents are but little disturbed. No difficulty is experienced in recognizing the bladder wall which is easily distinguished from other tissues and structures by the large and tortuous veins coursing over its surface, for the most part in an upward and downward direction.

Having located the summit of the bladder, a small quantity of the novocain solution is injected near to the line of the peritoneal reflection and at this point the bladder wall is grasped by tenaculum forceps. Gentle traction is exerted in an upward direction, using the tenaculum to steady the bladder wall, and the anesthetic solution is injected in a line extending downwards for a distance of approximately five cm. The bladder cavity is then opened, the size of the opening being made sufficient to admit only the index finger. This is accomplished by introducing the knife, with its cutting edge turned towards the pubic bone, into the bladder cavity at a point just below where the bladder wall is grasped by the forceps.

The finger is immediately introduced into the bladder cavity and acts as a plug to prevent the escape of urine, the examination of the interior of the bladder being more easily and satisfactorily made when the viscus is distended. It must first be determined whether the opening is properly placed in relation with the summit of the bladder. If placed too low, the peritoneum must be carefully dissected away and the incision enlarged upward, or in some instances an entirely new

opening must be made. Digital examination of the interior of the bladder is made before enlarging the opening. The post-prostatic pouch is searched for calculi and if the cystoscopic examination revealed the presence of diverticula the attempt is made to explore their cavities; the characteristics of the intravesical portion of the prostate next engage our attention.

If calculi are found the bladder incision is enlarged to the required dimensions and they are then removed; otherwise the incision is enlarged only to a size sufficient to admit a large Freyer, or a Marion

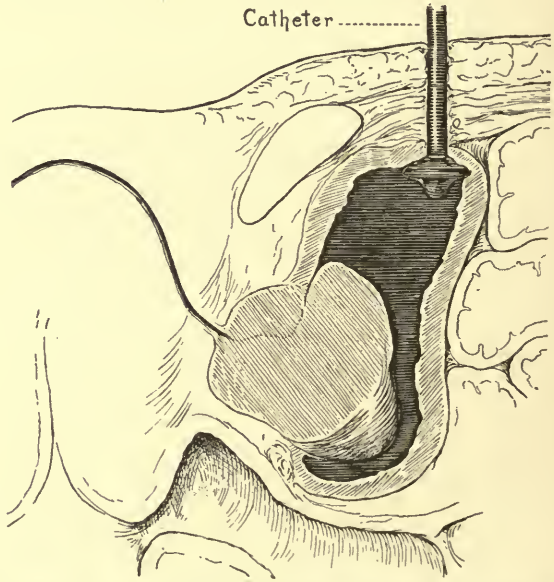

Fig. 96.—The dePezzer Catheter in the Proper Position for Preliminary Drainage.—(*Pilcher, Cabot's Urology.*)

drainage tube. The latter is anchored by a single suture of chromic catgut to the incisional margin and the opening is closed tightly around the tube. The latter is made to emerge from the upper angle of the incision.

We attach considerable importance to the level at which the end of the drainage tube is placed in relation to the bottom of the postprostatic pouch. It should almost touch the bladder wall to insure complete siphonage of its contents.

The bladder with the drainage tube in position is permitted to fall back into the pelvic cavity and the incision is closed by continuous catgut suture of the rectus sheath and through and through sutures of

silkworm gut. It is our practise to anchor the badder to the rectus muscle by a catgut stitch in many cases.

The position of the drainage tube in its relations with the abdominal wall is determined after the bladder has been allowed to fall back into the pelvic cavity, when if the tube is moderately rigid, it will naturally assume the proper position.

The space of Retzius need not be drained if care be taken not to lacerate its fibro-fatty contents. But carrying a piece of rubber drain down to the space can do no harm.

We prefer a drainage tube of very large caliber, 25 mm. in diameter, for routine use. In certain cases, as previously mentioned, in which it is desirable to establish drainage in the shortest possible time and in which prolonged drainage will, in all likelihood, be necessary, we sometimes use a dePezzer catheter, or the Pilcher modification of this instrument.

This technique as devised by Pilcher who advises it for routine use in the two-stage operation, will be described in detail later; suffice it to mention here a few details in its use which we have found advantageous in cases of acute retention.

Under local anesthesia the greatly distended bladder is exposed by as limited a dissection as is possible. In these cases there is little or no danger of wounding the peritoneum and there is likewise little danger of placing the bladder incision too low.

Having exposed the bladder wall, the button-like end of the dePezzer catheter is folded and grasped in the jaws of a pair of small dressing forceps and its distal end plugged. The scalpel with its cutting edge turned downwards is then quickly plunged through the bladder wall and immediately the dressing forceps carrying the catheter are introduced through the opening into the bladder cavity. The forceps are opened, thus releasing the catheter, and are then removed. The button-like end of the catheter is drawn tightly against the bladder wall, thus effectually plugging the opening so that practically no urine escapes.

If the incision is not too large, it is unnecessary to use sutures except to anchor the tube to the bladder wall. The wound is then closed in the usual manner.

The bladder is gradually emptied by removing the plug from the catheter from time to time. If the patient's condition is good he may be lifted out of bed on to a chair the following day. This not only minimizes the dangers of pulmonary congestion and senile pneumonia, but the patient is impressed with the apparent innocuousness of the

operation so that he will undergo the second stage without fear and in full confidence of his ability to "get well." The bladder drainage may be continued for a month or more without leakage of urine and under circumstances that are ideal for repeated functional kidney studies, and if subsequent removal of the prostate is contra-indicated, the dePezzer catheter may be removed and a silver cannula substituted for it as a means of permanent drainage.

SECOND STAGE—REMOVAL OF THE PROSTATE GLAND

Having determined the fitness of the individual for prostatectomy he is again prepared for operation in the usual manner. The bladder is thoroughly irrigated through the tube with a warm solution of oxy-cyanid of mercury (1–10,000), before the patient is brought to the operating room. For anesthesia we choose either nitrous-oxide oxygen or ether. If the second stage succeeds the cystostomy operation within a period of ten days the sutures above the drainage tube are not removed. If a longer period of time has elapsed the stitches will have been removed and the wound is firmly healed. It will then be necessary to enlarge the wound downward; this is especially true if a dePezzer catheter has been employed for drainage. In cases in which a very large tube has been used, digital dilatation of the opening usually gives ample room for the enucleation of the prostate although some difficulty may be experienced in delivering the freed prostate from the bladder cavity, indeed, it is necessary in some instances either to enlarge the opening or to section an unusually big prostate before it can be brought out of the bladder cavity.

Having removed the drainage tube and provided an opening of sufficient size, the removal of the prostate is effected according to the principles already described.

The second stage of a two-stage prostatectomy differs only in minor details from the one-stage operation, except as concerns the enlargement of the wound and in the treatment of complications of which hemorrhage is the most important. Hemorrhage is one of the commonest causes of death after prostatectomy and in the vast majority of cases it is controllable. Patients rarely die as the result of the loss of blood during the operation; it is the bleeding that occurs after the patient is returned to the ward or recovery room that proves fatal. The time to control this bleeding is at the time of operation, not after several hours of waiting to see whether it will stop spontaneously. It is absolutely unjustifiable to send a patient from the operating table who

is bleeding; prostatic surgery offers no exception to this surgical principle.

Serious bleeding is less likely to follow prostatectomy in cases which have had preliminary drainage because of the relief of congestion incident to such drainage. It does occur, however, and active measures must sometimes be taken to arrest it. Our technique does not differ in this respect from that employed in the ordinary prostatectomy; the wound is opened widely, the bleeding area is exposed, and if possible the bleeding vessel or vessels are ligated. Failing in this the prostatic bed is packed with a strip of gauze, one end of which is brought out through the suprapubic opening. The gauze is held securely in place by a purse string suture in the mucosa surrounding the vesical side of the prostatic bed.

This procedure is attended with some difficulties in patients who have had preliminary drainage, but we much prefer it to any of the other methods proposed. Some surgeons prefer not to enlarge the opening and are willing to trust to the pressure of a Hagner or Pilcher bag for the control of bleeding. The descriptions of the latter methods together with certain other variations in technique, are given elsewhere.

The after-care of patients operated upon in two stages differs not at all in our clinic from that practised after a one-stage prostatectomy.

Suprapubic Prostatectomy—Modifications in Technique.—The technique of enucleation of the prostate gland has undergone many modifications especially in respect to the manner of beginning the enucleation. It will be recalled that Freyer recommended that an incision be made parallel with the urethra through the vesical mucosa covering the most prominent part of the intravesical projection and beginning the enucleation at this point. Attention was called to the fact that this portion of the prostate is covered merely by mucous membrane beneath which lies, what Freyer believes to be, the true capsule of the gland.

Fuller of New York had previously recommended that a cut be made through the median lobe or bar with scissors, and that this incision extend from the lower margin of the internal vesical opening of the urethra backward for an inch to an inch and a half. Through an incision of this kind he did what was undoubtedly the first complete prostatectomy. Freyer however, popularized the operation and modified it to the extent that the incision was placed over the most prominent part of the intravesical projection. He also recommended that the finger nail instead of the scissors be used for cutting through the vesical mucosa.

We soon adopted the technique as described by Freyer but found it ad-

vantageous to make a second incision over the other lateral lobe when there was considerable intravesical projection. Other modifications in the technique—for the most part of minor importance—were evolved. Perhaps the most important of these, certainly the one that has caused most discussion, was our advocacy of simple extirpation of pedunculated median lobes leaving the bulk of the prostate untouched. This of course was the principle of the McGuire operation. As we have explained, it is rarely indicated for the reason that isolated prostatic nodules giving rise to urethral obstruction seldom occur; when they do occur and the prostate is not hypertrophied throughout, the latter, we repeat should not be disturbed.

Fig. 97.—Intra-urethral Enucleation of the Prostate.
Step 1. (*J. Bentley Squier, Surgery, Gynecology and Obstetrics,* 1912, xv, 599.)

After meeting with certain cases in which folds or tabs of mucous membrane caused obstruction to urination after prostatectomy it was proposed that an incision be made through the vesical mucosa covering the intravesical portion of the prostate in an encircling manner; to this the fanciful name of circumcision of the vesical outlet was given.

The technique of the subsequent enucleation of the prostate differed to some extent with individual operators but the fundamental principles

were quite the same as those enumerated by Fuller and Freyer. These we have already described.

The fact that the so-called hypertrophied prostate really consists of a group of adenomata or rather, adenomatous masses, more or less firmly bound together and originating within the prostate gland, must be borne in mind during the enucleation. If our conception of the pathology of the condition is correct, these nodules have formed a false capsule as the result of pressure. This capsule consists of compressed prostatic tissue which has not participated in the neo-formation, and of the peripheral fibromuscular stroma or true capsule. Within the envelope and more or less loosely attached to it lies the part of the prostate that will be removed. Outside of the envelope and almost inseparably bound to it is the sheath of the prostate which is merely a visceral prolongation of the pelvic fascia.

Fig. 98.—Intra-urethral Enucleation of the Prostate.
Step 2. (*J. Bentley Squier, Surgery, Gynecology and Obstetrics.*

This sheath is deficient in the region of the vesical outlet and through this hiatus the enlarging prostate enters the bladder. The major pressure on the true capsule and on the compressed, but otherwise normal prostatic tissüe, is exerted here, and it is reasonable to suppose that these tissues undergo partial if not complete atrophy, so that the tumor itself comes to be directly beneath the vesical mucosa.

This fact explains also why the line of cleavage between the false capsule and the tumor mass, which it surrounds, is sometimes found with difficulty when the enucleation is begun from the vesical side.

The sphincter muscle is not directly attached to the tumor but is separated from the latter by such parts of the false capsule as exist in this area.

FIG. 99.—INTRA-URETHRAL ENUCLEATION OF THE PROSTATE. Step 3. (*J. Bentley Squier, Surgery, Gynecology and Obsetrics.*)

If we accept the views of Tandler and Zuckerkandl, namely, that the great majority of cases of prostatic hypertrophy begin in the middle lobe tubules and remain localized to this structure, and that the lateral posterior lobes suffer pressure atrophy, we must materially change our technique relative to the steps in the enucleation.

It has been established beyond dispute largely, as the result of Lowsley's investigations, that the posterior lobe tubules which lie posterior to the ejaculatory ducts, rarely, if ever, take part in benign hypertrophy. The ejaculatory ducts traverse the prostate gland on a plane lying between the posterior lobe tubules behind and the middle and lateral lobe tubules in front. If, as is generally believed, the

latter structures alone are involved in the hypertrophic processes, it follows that the ejaculatory ducts will be displaced posteriorly and will not be disturbed by prostatectomy, provided that part of the floor of the urethra anterior to and including the verumontanum is preserved. These ducts open into the sides of the anterior declivity of the verumontanum.

In the light of our present knowledge this then is the ideal to be attained, namely, to remove the prostate or rather to remove the adeno-

FIG. 100—INTRA-URETHRAL ENUCLEATION OF THE PROSTATE. Step 4. (*J. Bentley Squier, Surgery, Gynecology and Obstetrics.*)

ma-like masses originating in the prostate without destroying the ejaculatory ducts or that portion of the floor of the urethra into which they open. That this is always possible, we much question; that it is the result to be aimed at is undoubted.

In describing the enucleation of the prostate by the Freyer method some lines were devoted to an argumentative consideration of the possibility or impossibility of sparing the ejaculatory ducts. We believe it is impossible to remove the prostate according to the Freyer technique without destroying the prostatic urethra in practically every instance.

To Squier of New York is due the credit for having evolved a technique of suprapubic removal of the prostate which theoretically and probably actually in the majority of instances, allows of preservation of the ejaculatory ducts. His method isf ounded on careful studies of the normal anatomy of the parts and the changes to which they are subjected as the result of prostatic disease. He takes into careful consideration also the bearing of the pathogenesis of the disease on the surgical problems of enucleation.

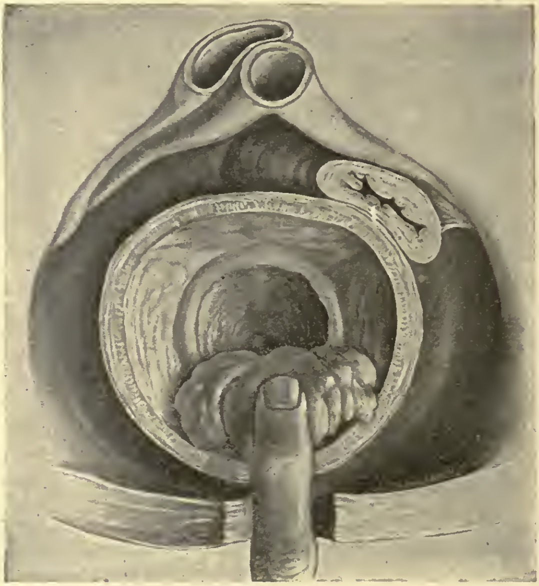

FIG. 101.—INTRA-URETHRAL ENUCLEATION OF THE PROSTATE. Step 5. (*J. Bentley Squier, Surgery, Gynecology and Obstetrics.*)

In addition to less important considerations, Squier calls attention to the backward displacement of the ejaculatory ducts in hypertrophic states of the prostate. He likewise points out the importance of the fact that "the urethra anterior to the colliculus is practically free from the prostate, but posterior is quite intimately attached."

Since the ejaculatory ducts are out of harm's way posteriorly, it follows that if the colliculus and adjacent urethral floor can be spared, the terminals of these ducts will likewise be spared. This is not a difficult matter if the prostate is easily enucleable and if the urethral mucosa is divided primarily on a plane posterior to the colliculus; the anterior portion being but slightly attached will have little tendency to adhere to the prostate.

The preservation of this part of the urethra with the ejaculatory ducts while undoubtedly of importance in the preservation of the sexual function, is really of minor importance in comparison with the greater facility and safety to the sphincter mechanism of the bladder when the prostate is removed by the Squier method. We are in the habit of beginning the enucleation by tearing through the mucous membrane covering the most prominent portion of the growth in the urethra; this almost invariably lies posterior to the colliculus but on the side wall of the urethra. In some few instances it facilitates matters to begin the enucleation on the floor of the urethra.

Squier's Operation.—Squier's operation is described by its originator as follows:

"We will presume that all operative preliminaries are completed even to the filling of the bladder, the arrangement of the towels, etc., and the surgeon is ready to operate before the anesthetic is commenced. At the moment of relaxation, the abdominal incision is made and the bladder exposed. The bladder is opened by an incision large enough to admit two or three fingers, high up on the fundus and close to the peritoneal attachment. This may seem to be a trivial matter, yet it has a direct bearing upon the time required for the healing of the suprapubic sinus.

"The next step in the operation, namely, enucleation of the prostate is necessarily the most important one.

"We have been taught to remove the prostate from its sheath through an opening into the bladder mucous membrane over its most prominent lobe. Such an enucleation is, therefore, started intravesically. The finger dissects forward, meets with the fibres of the internal sphincter and external longitudinal muscles where they encircle the prostate at the line of demarcation between intra- and extra-vesical portions, and the tendency is for the finger to pass outside the muscular covering of the prostate and thus remove the prostate as a whole rather than the lobes separately. This so-called removal *en masse* is characteristic of Freyer's operation, in which no effort is made to save the prostatic urethra but a removal of the prostate with its encircling muscle fibres is aimed at.

"The method of enucleation which I prefer varies from this description in that enucleation is begun extravesically. It is recommended because it materially reduces the length of the time of operation, on account of the rapidity by which the prostate can be shelled out, as well as by lessening the chance of damaging the ejaculatory ducts.

"The procedure is to insert the finger into the internal meatus and break through the roof of the prostatic urethra. Access is at once given to the proper line of cleavage between the lobes, since at this point they lie in close opposition, being separated only by the capsule.

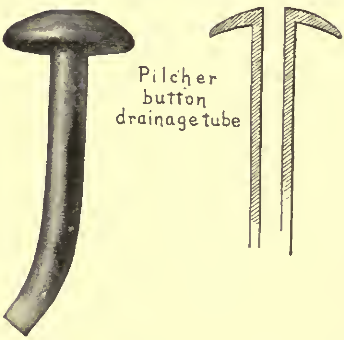

FIG. 102.

FIG. 103.—THE PILCHER HEMOSTATIC BAG.

"The enucleation is begun by pushing the finger upward and forward, freeing the apex of the lobe from its attachment to the urethra and triangular ligament. It is then swept around the surface, and the lobe

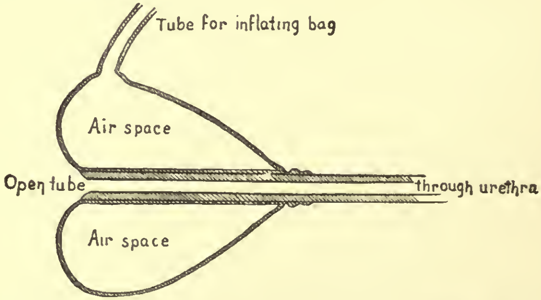

FIG. 104.—SAGITTAL SECTION OF THE PILCHER BAG.—(*Pilcher, Cabot's Urology.*)

is hooked back into the bladder with its apex pointing upward, then a little separation from the bladder mucous membrane completes its removal. A similar procedure is repeated on the other side and the enucleation is complete. The moment the prostate has been delivered the anesthetic is stopped.

"With a little care there is no danger of injury to the rectum. An assistant steadies the prostate through the rectum during enucleation. The operator should not do so as it interferes with the immediate completion of the operation because of the necessity of resterilization of the hands and changing of gloves.

"Carried out in this way, a suprapubic prostatectomy can be accomplished in four or five minutes in most cases, and the patient need be subjected to complete anesthesia but two or three.

"Therefore a prostate without median outgrowth may be enucleated with practically no damage being done to the floor of the prostatic urethra. In cases where a median outgrowth exists, a part of the floor of the prostatic urethra, namely, that portion which is posterior to the colliculus, will come away with the prostate on account of its intimate attachment through the prostatic ducts.

FIG. 105.—THE HAGNER HEMOSTATIC BAG.

"Whether or not this portion of the urethra is removed is of no great moment. It is, however desirable to preserve the integrity of the prostatic urethra anterior to the colliculus, as here are situated the openings of the ejaculatory ducts. Fortunately nature aids us in so doing, as the part of this urethra is not intimately attached to the prostate and, therefore, remains.

"The operation just described is not only applicable to prostates in which hypertrophy is of the glandular type. It has been the most efficient means of removing the small, hard, fibrous prostate whose growth is practically extravesical."

Pilcher's Operation.—Pilcher recommends that the principles of anoci-association be employed whenever possible in operating upon prostatics. Local anesthesia is employed for preliminary cystostomy.

The night before operation the patient is given thirty grains of sodium bromide and this is repeated on the morning of the operation. Morphine, grain 1/4 combined with atropine, gr. 1/150 is given by hypodermic one half hour before the operation in many cases. The local application of the principles of anoci-association both during the cystos-

tomy and later in enucleating the prostate as recommended by Lower are followed.

I. An hour before the operation the patient is given a hypodermic injection of morphine and scopolamine, the size of the dose depending upon the age of the patient.

II. Immediately before the operation the bladder is irrigated and 60 to 99 cc. of a five per cent. solution of alypin is injected through the catheter. The catheter is clamped and both catheter and solution are allowed to remain.

III. The bladder is approached in the usual way except that the skin incision and every division of tissue is preceded by a thorough infiltration with novocain in $\frac{1}{400}$ solution.

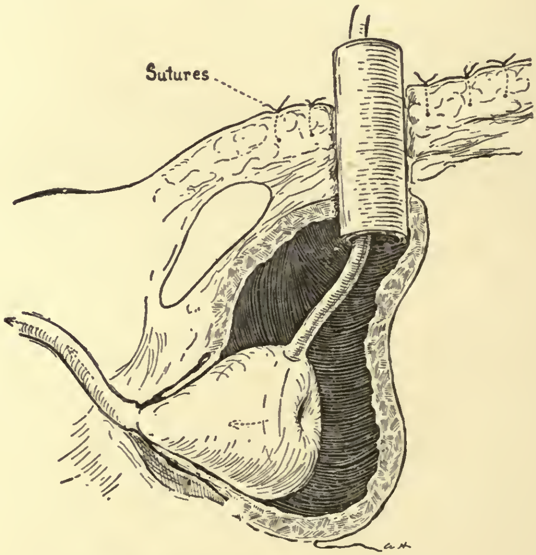

FIG. 106.—HEMOSTATIC BAG IN PLACE.

The inflating tube is passed up through the large drainage tube. In two or three hours the bag is allowed to deflate and the pressure is relaxed. If bleeding recommences, the bag is re-inflated and pressure re-established. The bag is removed in twenty-four hours.—(*Pilcher, Cabot's Urology.*)

IV. When the bladder is exposed it is elevated with curved hooks and thoroughly infiltrated with novocain solution.

Technique of Suprapubic Cystostomy. (Pilcher.)—The bladder is exposed through a mid-line incision in the usual manner. It is then well filled with sterile water through a catheter introduced by the urethra.

The finger is introduced into the wound until the under surface of the symphysis pubis is reached; then the finger covered with gauze is

slowly swept upward, gradually lifting the tissues away from the anterior surface of the bladder at the same time forcing the peritoneal fold upward.

Great care must be exercised in pushing back the peritoneum for it is easily torn.

The bladder having been properly exposed, retractors are introduced, two lateral ones to hold back the muscles and one in the upper angle of the wound to hold back the peritoneum.

Two retaining sutures are then introduced into the blader wall about an inch apart on either side of the point where the bladder is to be incised. This incision is made as near to the peritoneal fold as possible. The fluid is then allowed to flow out of the bladder through the urethral catheter. Then the bladder is opened at the point chosen. Digital exploration of the bladder cavity follows. With this completed the button drainage tube is inserted and fixed in place either by a purse-string suture of chromic gut or silk, or by tying the stay sutures around the tube.

Pilcher lays much emphasis on the importance of placing the drainage tube in the proper position. He recommends that a second opening be made if the primary opening in the bladder wall is found placed too low. Closure of the prevesical space by catgut suture is also advocated.

The wound is carefully closed by interrupted chromic gut sutures. Interrupted silk sutures are used to close the skin incision and the drainage tube is fixed to the skin by means of an adhesive strip. Wound infection seldom occurs.

General anesthesia is rarely necessary in performing cystostomy, according to Pilcher; spinal anesthesia is not employed.

The Convalescent Period.—Drainage of the bladder is begun as soon as the patient reaches his room. This may be continous if there has been only a small amount of residual urine. Otherwise continuous drainage should be avoided for some days, the bladder being emptied intermittently. Irrigation of the bladder is not advised during the first three or four days.

Pilcher states that primary union of the wound is secured with complete control of the urine; further that the prevesical and perivesical spaces have been eliminated from the surgical problem and half of the operation of transvesical prostatectomy has been completed without the employment of general anesthesia and with freedom from surgical shock.

Enucleation of the Prostate.—Ether by the drop method is recommended. The application of the principles of anoci-association as outlined by Lower is given in detail. This embodies the hypodermic infiltration of the prostate gland and its capsule with novocain solution. The needle of the syringe containing the novocain solution is introduced into the prostate through the suprapubic opening using the finger as a guide.

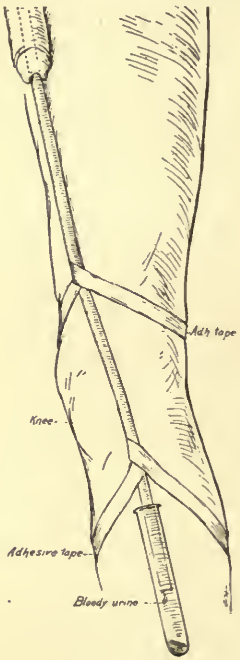

FIG. 107.—METHOD OF ATTACHING CATHETER TUBE OF PILCHER BAG TO THE LEG BY MEANS OF ADHESIVE PLASTER TO KEEP UP INTRA-VESICAL PRESSURE ON THE PROSTATIC BED.—(*Pilcher, Cabot's Urology.*)

If two weeks or less have elapsed since the cystostomy operation it is unnecessary to use instruments to enlarge the drainage opening; the silk sutures should not be disturbed. If the sutures have cut through it is sometimes advantageous to re-insert heavy silk sutures to prevent the wound from tearing open during the enucleation of the prostate.

In cases in which a long time elapses between the two stages of the operation it will probably be necessary to enlarge the opening. Pilcher speaks of this merely as being of advantage, but we have found it absolutely necessary in cases in which a button drainage tube has been used.

To enlarge the suprapubic opening Pilcher suggests making three radiating incisions one inch in length, extending on each side of and downward from the opening. These incisions are carried to the rectus sheath. The latter may be incised when necessary and to gain additional room the subcutaneous fat surrounding the wound may be excised. The wound should not be enlarged upward on account of the danger of injury to the peritoneum.

Having provided the necessary opening the enucleation of the prostate is begun. The technique advocated by Pilcher is in no wise different from the usual intra-urethral enucleation. For cases in whieh median lobe enlargement is lacking but with great enlargement of the lateral lobes, Pilcher recommends that the enucleation be begun on the vesical side after the method of Freyer.

Attention is called to the importance of thoroughly cleansing the bladder after the removal of the prostate. This includes the removal

of blood clots, loose pieces of tissue, and of small prostatic calculi that may have become dislodged during the manipulations. Cleansing of the bladder is best accomplished by wiping the debris away with small gauze sponges.

The use of the button catheter for suprapubic drainage and the method of controlling hemorrhage after removal of the prostate are among the characteristic features of the Pilcher operation. The

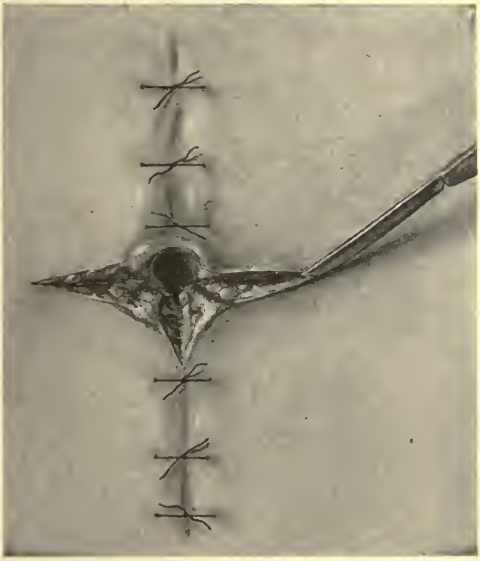

Fig. 108.—"Enlarging the Suprapubic Opening after Cystostomy when a nearer Approach to the Prostate is Desired. The Wound is not Enlarged Upward because of the Danger of Opening the Peritoneal Cavity."—(*Pilcher, Cabot's Urology.*)

latter he accomplishes by means of the bag hemostat, an instrument originally suggested by Hagner but used in an improved form by Pilcher.

To place the bag in the prostatic bed, a silver prostatic catheter is passed through the urethra into the bladder after the removal of the prostate; its tip is caused to emerge through the suprapubic wound and the rubber tube which is attached to the bag is fitted over the end of the catheter to which it is firmly tied; the end of the catheter is then withdrawn carrying with it, through the urethra, the rubber tube. The bag is then inflated and the tube clamped off.

The desired pressure on the prostatic bed may be obtained by exerting traction on the tube. The latter is attached to the leg by means of adhesive straps, thus completely controlling the degree of pressure exerted at the vesical neck.

Pilcher's modifications of the Hagner bag consist of the addition of a catheter arrangement and of a second tube which is used to inflate the bag. The latter is brought out through the suprapubic wound. The urethral tube passes through the bag and serves the purpose of a catheter.

FIG. 109.—TIP OF THE FINGER INTRODUCED INTO VESICAL PORTION OF THE URETHRA. (*Pilcher, Cabot's Urology.*)

Removal of the bag is easily accomplished. If the suprapubic drainage tube is of large diameter the deflated bag may be removed through its lumen without disturbing the tube. The Hagner bag is provided with a silk ligature which, like the tube of the Pilcher bag, is brought out through the drainage tube. The silk ligature serves for the removal of the bag. It is generally desirable to remove the drainage tube and the bag at the same time.

Pilcher recommends that air be used to distend the bag; we have employed hot water with gratifying results; it has also been suggested that metallic mercury be used for the same purpose.

In Pilcher's opinion every case should be drained after prostatectomy; with this we thoroughly agree. He recommends the use of a large drainage tube which should not extend more than a half inch

within the bladder cavity. This is in addition to the drainage by the catheter *per urethram.*

After-Treatment.—A considerable degree of pressure is exerted on the prostatic bed for the first hour after prostatectomy.

The adhesive strips attached to the leg are then cut and the bag is deflated but is left in situ lest secondary bleeding should occur. It is

FIG. 110.—SEPARATION OF THE SPHINCTER MUSCLE FROM THE PROSTATE.—(*Pilcher, Cabot's Urology.*)

removed in from twenty-four to forty-eight hours. Should an excessive amount of blood appear in the drainage fluid the bag is again inflated and traction exerted on the urethral tube, as before.

In the absence of complications, the patient is allowed to sit up in a chair the day following operation. If the bag gives rise to discomfort it may be removed together with the suprapubic drainage tube, at the end of twenty-four hours; otherwise they are not disturbed until the end of the forty-eight hour period.

To remove the bag it is merely necessary to deflate it—to cleanse the distal end of the urethral tube and apply to it a sterile lubricant, and to cut the suture holding the suprapubic drainage tube; the latter, together with the bag may now be withdrawn through the suprapubic wound.

The patient will not suffer any pain if the bag is withdrawn slowly and with gentleness.

The deflated bag may be removed without disturbing the suprapubic drain if the latter is wide enough to permit its passage.

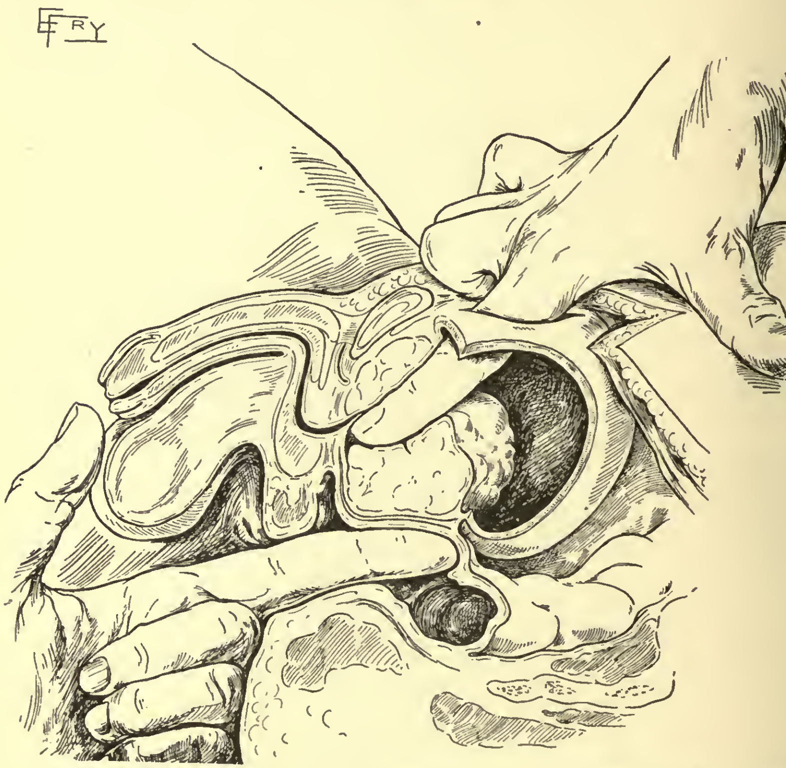

Fig. 111.—"After Freeing the Internal Sphincter, the Finger is forecd through the Prostatic Urethra to its Utmost Distal Point and Here the Real Enucleation of the Gland is Begun. With one Finger in the Rectum, and One Finger in the Bladder the Gland can be Almost Entirely Controlled. If Enucleation with One Finger is difficult, it will be found that by using the First and Second Fingers Enucleation is Facilitated."—(*Pilcher, Cabot's Urology.*)

We prefer not to remove the drainage tube, but Pilcher recommends the early substitution for it of a button-catheter introduced into the bladder immediately after the drainage tube is removed, using as a guide for the purpose, a long narrow retractor.

The enlarged end of the button-catheter is grasped with a pair of dressing forceps which are made to follow along the groove of the narrow retractor into the cavity of the bladder. The catheter is then released and the forceps and retractor are withdrawn. According to Pilcher,

the bladder wall contracts immediately and holds the catheter in place. It serves he says to completely drain the urine away in most cases so that the patient is kept dry. The button catheter is not removed until the patient has begun to pass the urine *per urethram.* If success attends this first effort the patient will have little trouble in regaining the normal function of his bladder.

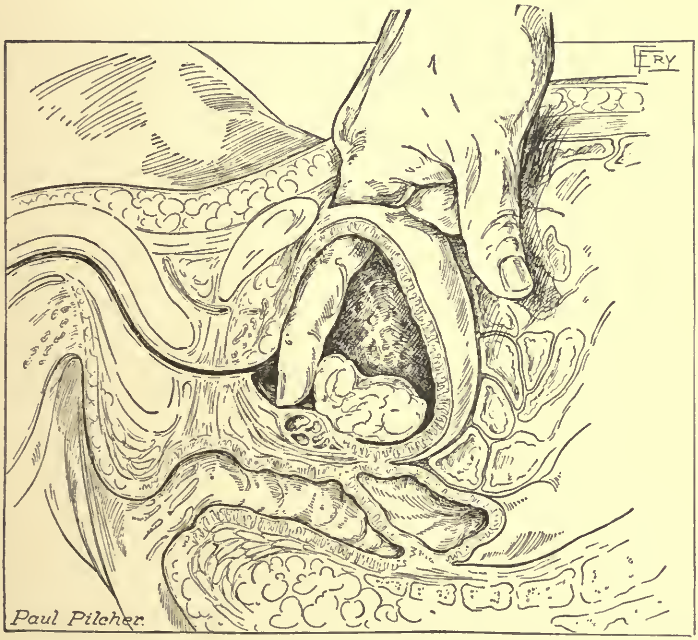

FIG. 112.—ENUCLEATED PROSTATE TURNED OUT INTO THE BLADDER.—(*Pilcher, Cabot's Urology.*)

Most of the patients will not need the drainage tube after the tenth or eleventh day, and when it is removed there is very little leakage of urine through the sinus which quickly closes.

Judd's Operation.—This differs in some respects from the operation of suprapubic prostatectomy as it is ordinarily performed, especially in the manner of controlling hemorrhage. Judd also advocates primary closure of the suprapubic wound in selected cases, depending entirely upon a catheter *per prethram* for drainage.

A wide exposure of the prostatic area is provided through a suprapubic opening of generous dimensions. Self-retaining retractors aid in the exposure of the operative field.

The prostatic mass is grasped with forceps, if this is practicable,

and is lifted up and steadied while the enucleation is proceeded with. The latter is begun much after the method of Freyer, the gland being separated first from the sphincter muscle and bladder walls.

After the prostate has been freed and removed from the bladder, the cavity whence it came is carefully inspected. Spurting vessels are clamped and tied with catgut. The torn edges of the vesical mucous membrane are caught with clamps and a few sutures of chromic catgut are inserted. These are placed so as to include the bladder wall and the adjacent sides of the prostatic bed; when they are tied all bleeding from the vesical mucosa is controlled.

The area is again examined carefully and if all bleeding is controlled a catheter is passed *per urethram* for drainage and the suprapubic wound is tightly closed.

Perineal Prostatectomy.—So many variations and modifications of this operation have been suggested that a minute description of each in a work of this kind would be impracticable. All of the methods employed, however, may be classed in either one of two categories—those in which the gland is removed from within the urethra through a straight perineal incision, and the extra-urethral perineal prostatectomy, as seen in the technique of the French School developed by Proust and popularized, in a modified form, by Young in this country.

Perineal removal of the prostate or of parts of it through a small perineal incision is rarely if ever practised at the present time, although this was the perineal operation advocated by many American surgeons before the elaborate dissections of the perineum characteristic of the Proust and Young operations came into popular favor. Likewise with the perfection of the latter, the intra-urethral perineal operations have gradually fallen into disuse.

Intra-urethral Perineal Prostatectomy.—The credit for the development of the intra-urethral method of perineal prostatectomy is due to Goodfellow who, in collaboration with Wishard, introduced it to the profession in 1891.

The first of the modern operations of extra-urethral perineal prostatectomy—that of Zuckerkandl—antedated this by several years. It should not be forgotten that Goodfellow's operation antedated the transvesical or suprapubic operation of Fuller and Freyer.

Dr. Goodfellow's own description of his operation is as follows: "The usual pre-operative procedures are carried out. . . . With the patient in the ordinary lithotomy position, the legs held by assistants, the bladder being empty or full as the case may be, a lithotomy

staff is introduced, the legs then elevated somewhat, a median incision from the base of the scrotum to the margin of the anus is made, and carried to the membranous urethra, which is entered with a straight lithotomy knife and the opening extended *into* the bladder. The finger is then introduced *into* the bladder, the staff removed, and the moderate flexion of the legs and thighs on the abdomen and the thorax increased to as great an extent as possible; then with the opposing hand over the hypogastrium the bladder is depressed, and the enucleation, beginning

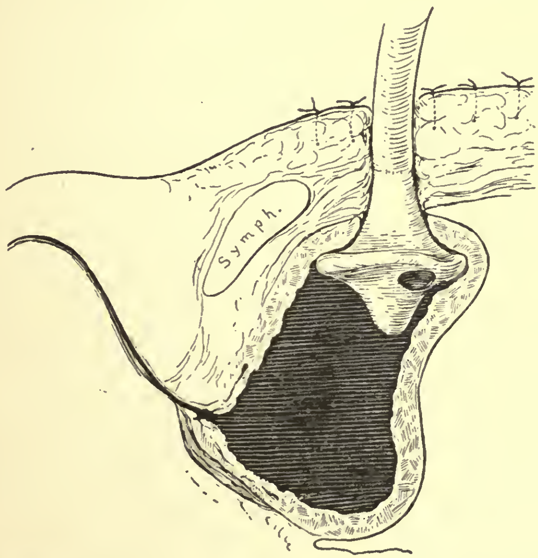

FIG. 113.—THE DEPEZZER CATHETER IN PLACE AT HIGH POINT OF BLADDER.—(*Pilcher, Cabot's Urology.*)

at the beak of the prostate below and working upward next to the bladder, or from above on either side downward, is carried on, the time consumed for complete enucleation rarely being over five or ten minutes, the resulting hæmorrhage being virtually nothing. The gland may be removed entire or lobe by lobe. . . . What becomes of the prostatic urethra? has been asked. The answer is that part or all is removed with the gland, an incident that in no manner seems to affect the restoration or the continuity of the urethra, nor the power of the bladder to regain and control its functions; nor is stricture or occlusion caused. The seminal ducts are not ligated, for this seems to me an irrational refinement, especially as many of my patients have (so they say) to a greater or less extent regained sexual vigor."

"The points to be expressly emphasized are the position and the

incision *into* the bladder. . . . I do not find it necessary now to use the knife to enter the urethra and bladder. After cutting to the

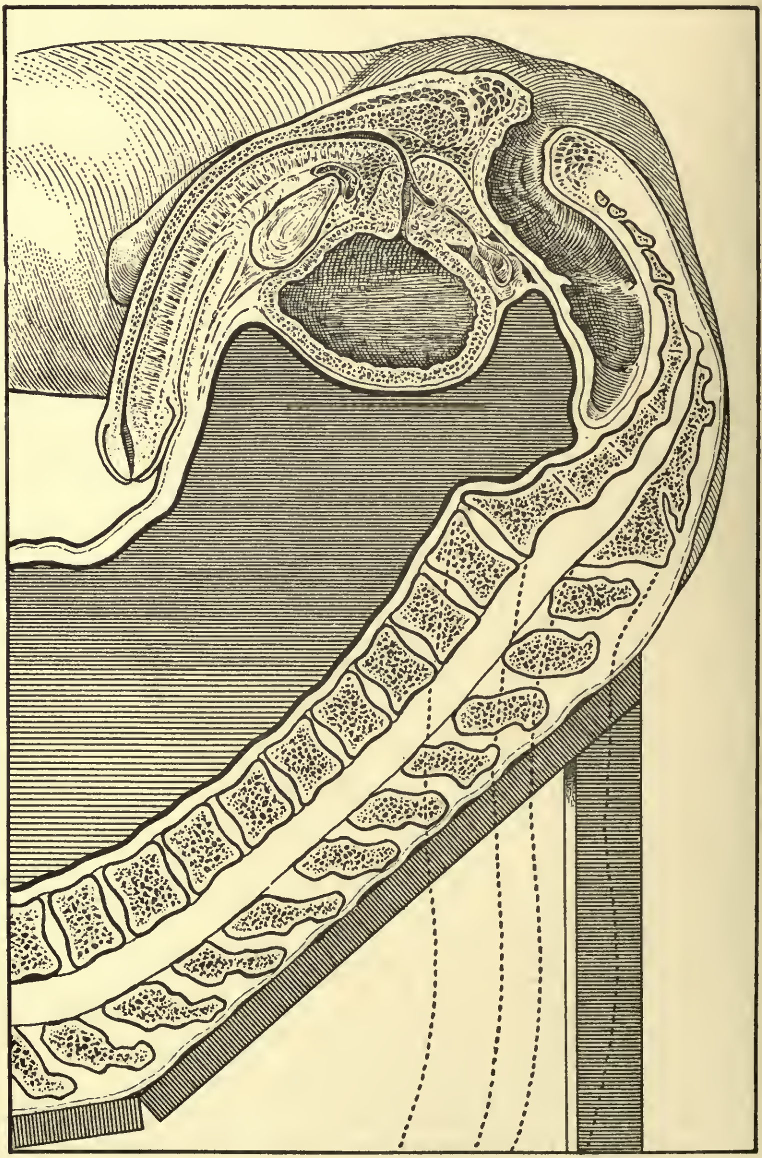

FIG. 114.—PROUST'S INVERTED PERINEAL POSITION FOR PERINEAL PROSTATECTOMY.

urethra I am able with the finger to open it and get into the bladder by a boring movement. Then not having a cut through the commissure, I enucleate from above instead of from below as formerly."

American surgeons, among whom may be mentioned Alexander, Syms, Ferguson, Murphy, Watson, Cabot, Guitéras, Cunningham and Bryson, were enthusiastic in their support of the Goodfellow operation. Certain modifications and improvements in technique were

FIG. 115.—PERINEAL PROSTATECTOMY.—(*Proust.*)
The transverse perineal incision.

soon suggested and various instruments were designed to facilitate the removal of the gland. Difficulties in bringing the prostate within the reach of the finger were encountered and the pressure of an assistant's hand over the bladder, as advised by Goodfellow for the purpose, was

found insufficient. This led Nicoll and others to open the bladder above the pubis, introduce the hand or fingers into the bladder cavity and make direct counter pressure on the prostate during the enucleation.

To obviate the necessity for opening the bladder, Bryson, Guitéras, and others merely opened into the space of Retzius and, with the hand in this extravesical position, made the desired counter-pressure on the prostate.

Partly owing to the unsatisfactory results with the aforementioned methods, and doubtless also because of the introduction of practical prostatic tractors, the suprapubic incision was discarded.

Among the tractors that met with more or less favor may be mentioned those of Delbet, Albarran, dePezzer, Syms, Ferguson, and Guitéras. Various other instruments were introduced whose purpose it was to pull down the prostate; prominent among the latter were Murphy's hooks.

The development of the intra-urethral perineal operation had made considerable progress and many operators had expressed great, if not complete, satisfaction with the results attained, when Proust described his method of extra-urethral removal of the prostate through the perineum.

The Proust technique embodies the basic principles of perineal prostatectomy as it is now performed. What popular favor the operation now enjoys in this country, however, is due to the work of Young who modified the Proust technique and brought it to a high state of perfection.

With the introduction of extra-urethral prostatectomy the operations of Goodfellow and his followers fell more and more into disuse. Among the more prominent urologists who clung to the intra-urethral technique may be mentioned Watson whose method differed but slightly from that of Goodfellow.

Within recent years the intra-urethral operation has been practically abandoned, although A. J. Ochsner still advocates it but in a modified form. He employs a lateral perineal lithotomy incision through which the membranous and prostatic urethræ are cut posteriorly. Having thus opened the urethra, the finger is introduced into the bladder and the prostate is enucleated in exactly the same manner as with Freyer's technique. The freed prostate is then grasped with Young's forceps and removed. The left index finger is then introduced into the bladder and under its guidance the edges of the prostatic capsule are caught with fine tooth forceps and drawn downward. Two rubber drainage tubes, one within the other, are next introduced; the longer

inner one, whose diameter is one cm. drains the bladder cavity, the shorter outer tube, which fits snugly over the other, reaches only to the prostatic cavity. Ferguson retractors are then applied and gauze is packed into capsules around the drainage tubes. The outer tube is fixed to the margins of the incision by means of a silk worm gut suture, and the wound is closed in the usual manner.

In the event that a hard prostate is encountered, Ochsner advises its removal by means of Ferguson rongeur forceps.

Extra-urethral Perineal Prostatectomy.—This term is used to signify an enucleation of the prostate by a perineal dissection is carried out either entirely, or in part, outside of the urethra. The principles upon which the operation is founded were first outlined and given to the profession by Proust and Albarran of the French school in about 1900.

At this same time Young, of Johns Hopkins University, was engaged in the development of a technique for perineal prostatectomy, the details of which were described in the Journal of the American Medical Association, October 24, 1903.

Young states that his operation "was developed quite independently and without knowledge of the work of the French school to which however it bore resemblance, but only superficially."

If one reads very carefully the original descriptions of the Proust and Young operations he is impressed with the parallelism of the two procedures up to a certain point. True the skin incisions differ, and in certain instances, Proust advised lateral incision of the levator ani muscles, but until the actual beginning of the enucleation, the two operations are strikingly similiar. In each the urethra is exposed behind the triangular ligament; the dePezzer tractor which Proust employed to depress the prostate is very similiar to the Young tractor, but the methods of employing the two instruments were quite dissimilar.

Having inserted the dePezzer tractor and spread its blades over the vesical surface of the prostate, the instrument was used by Proust merely to steady the organ while freeing it from all of its attachments save where it was adherent to the urethra and ejaculatory ducts.

The enucleation was begun through an incision made in the sheath of the prostate where it covers the rectal surface of the gland. This incision was made parallel with the urethra but apparently did not, as do the incisions recommended by Young, go deeply into the compressed prostatic tissue (false capsule) which lies superficial to the hypertrophied lobes.

Having made an incision in the sheath, Proust advised that the finger be introduced into the space thus created and that the gland be freed by careful dissection on all surfaces, with the exceptions just noted. The retractor was then removed and the floor of the prostatic urethra incised. The finger was then introduced into the urethra and the remaining attachments of the prostate freed, care being taken to preserve the major portion of the urethral walls. The ejaculatory ducts were ligated routinely.

Evidently from this description, the Proust method of enucleation differed widely from that described by Young whose operation provides for separate removal of the lateral lobes through incisions placed lateral to, but parallel with the urethra.

It becomes evident from Proust's description of his operation that he failed to comprehend the essential points in the gross pathology of prostatic hypertrophy, or else he would not have commenced the enucleation between the sheath and the gland. Had he recognized the existence of a false capsule, as did Young, and deepened the incision on the posterior surface of the prostate so as to reach the line of cleavage between the hypertrophic portion and the false capsule, the entire enucleation could have been completed without incision into the floor of the urethra. Undoubtedly the prostatectomy of Proust insured a thorough and complete removal of the gland, but the virtues that this might seem to hold are wanting since it is not only unnecessary but materially adds to the gravity of the operation. Proust's operation is no longer advocated even by the French school of urologists.

The Young operation is superior to any other perineal prostatectomy thus far proposed; rarely do we follow the perineal route in operation on the prostate, but when circumstances indicate this as the preferable procedure the method of Young is chosen.

Perineal Prostatectomy—Technique of Young.—The operation of Young is an extra-urethral operation in the true sense of the word, since the enucleation of the prostate is done entirely from the outside and not in part from the urethral side, as recommended by Proust.

The method is called "conservative" perineal prostatectomy, its special feature being the preservation of the connection between the ejaculatory ducts and the urethra.

The position he advises may be characterized as the "exaggerated lithotomy position," the patient's thighs being fully flexed on the abdomen, so as to bring the perineum more nearly parallel with the floor.

Before elevating the thighs, a sound, which is to be used subse-

quently as a guide for the urethrotomy, is inserted into the posterior urethra.

The incision is shaped like an inverted V, the apex of which is placed over the posterior position of the bulb about five cm. distant from the anus. The arms of the incision are made parallel with the ischio-

Fig. 116.—Young's Sound Guide.

Fig. 117.—Young's Dissector, Sharp and Blunt.

Fig. 118.—Young's Boomerang Needle Holder.

Fig. 119.—Young's Bifid Retractor.

pubic rami, each one being about five cm. in length. The scalpel is carried to the level of the deep fascia after which the necessary exposure is obtained largely by blunt dissection.

The index finger is pushed through the soft cellular tissue to either side of the central tendon of the perineum, thus opening up a space which is bounded in front by the transverse muscles of the perineum and laterally by the levator ani muscles. With the displacement of these muscles a large cavity is exposed to either side of the central tendon into which the blades of a bifid retractor are placed.

The purpose of the retractor is to enable the operator to put the central tendon and associated muscles on the stretch in order that they

may be severed close to the bulb without danger of injury to the latter structure. At this stage of the dissection there is only slight danger of wounding the rectum. But having freed the musculo-tendonous structures from the bulb, the rectum is in great danger of injury if the knife or scissors are used recklessly, since it not infrequently is drawn forward in front of the membranous urethra by the recto-urethralis muscle.

This muscle lies between the levator ani muscles and covers, and is attached to the membranous urethra anteriorly, and to the anterior wall of the rectum posteriorly.

To properly expose the recto-urethralis muscle and thus avoid injuring the rectum when the muscle is divided, it is well to heed the advice of Young and pull the bulb forward with a suitable retractor before any attempt is made to divide the muscle. Indeed, the secrets of success in this operation are adequate skill in dissection to expose, and the anatomical knowledge necessary to recognize each individual structure. It is never permissible to incise a tissue until its identity and limitations have been determined.

The greatest danger in the operation,—injury to the rectum —arises during the division of the recto-urethralis muscle; there is, however, little likelihood of this occurring if the central tendon has been properly divided, the bulb displaced forward, and the division of the muscle made close to the urethra.

Having divided the recto-urethralis muscle, the rectum may be pushed backward thus exposing a space in which all of the subsequent steps of the operation will be carried out. This space is bounded posteriorly by the rectum, anteriorly by the prostate, the membranous urethra and deep perineal interspace within the confines of the triangular ligament, and laterally by the levator ani muscles.

By pulling the bulb forward a good view of the urethra between the triangular ligament and apex of the prostate is obtained. Posterior and lateral retractors aid in providing the necessary free exposure of the parts.

The next step in the operation is to incise the urethra in its long axis over the sound, at a point just distal to the apex of the prostate; this, which is in reality a part of the membranous urethra, comes into view only when the triangular ligament and its contained structures are displaced forward along with the bulb of the urethra.

The urethral incision should be no longer than is necessary to admit of the introduction of Young's prostatic tractor. Before removing

the sound from the urethra the edges of the urethral incision are caught up on either side with clamps or ligature, care being taken to include the mucous membrane. Failure to make a clean cut and especially to include the urethral mucosa in the clamps may be followed by the greatest difficulty in attempting to insert the tractor.

Having opened the urethra, and with the clamps properly and securely placed on the margins of the incision, the sound may be removed.

To facilitate the introduction of the tractor, the prostatic urethra is dilated with sounds introduced through the opening in the urethra. The insertion of the tractor is not always easy, especially in cases in which obstructing nodes of prostatic tissue have deformed the urethral lumen, but by rotating the instrument, turning its beak from side to side, etc., it can generally be made to enter the bladder cavity.

After assuring himself that the beak of the instrument has entered the bladder, the operator separates the blades and fixes them in position, a set screw being provided for the purpose.

The prostate is now drawn downward and forward by pulling on the tractor and turning it upward and backward over the symphysis pubis, the anterior retractor having been removed in the meantime. The prostate is, as it were, pried out of its normal position, the tractor acting as a lever with the pubic symphysis playing the role of a fulcrum. This description is figurative rather than real, since great traction is usually unnecessary to bring the prostate to the proper level, but it serves at least to illustrate the principles involved.

But one structure alone remains to be divided before full exposure of the prostate is obtained; this is the posterior layer of the fascia of Denonvillier which covers the rectal surface of the gland. A transverse incision is made through this fascial layer near to the apex of the prostate and the finger is then made to seek, and easily finds a space between it and the latter organ—"*l'espace décollable rétroprostatique.*" The anterior layer of Denonvilliers' fascia, which is inseparably bound to the prostatic sheath, is thus brought into view. By enlarging this incision the rectum is freely mobilized and not only the prostate but the seminal vesicles as well, are brought into view. The rectum may now be held with a retractor in such manner that it will not intrude itself upon the operative field.

This completes the preliminary stages of the operation, the most important part of which, namely, the enucleation of the gland, follows.

If the dissection up to this point has been done properly and with the various retractors held properly in position by assistants, an excel-

lent exposure of the posterior, or rectal surface of the prostate is

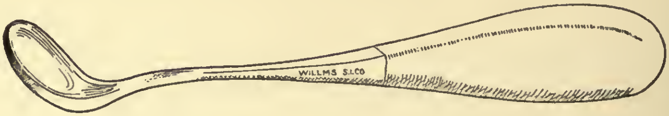

FIG. 120.—YOUNG'S SPOON TRACTOR.

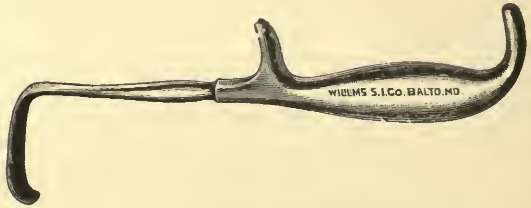

FIG. 121.—YOUNG'S LATERAL RETRACTOR

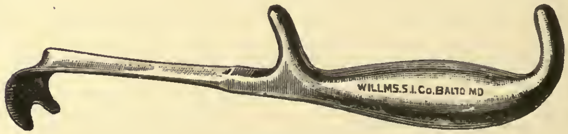

FIG. 122.—YOUNG'S RETRACTOR BULB

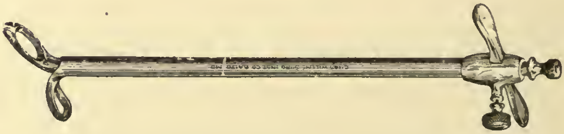

FIG. 123.—YOUNG'S PROSTATIC TRACTOR.

obtained; indeed, in many instances, the gland may be brought, almost if not actually, to the surface of the perineum.

The capsule is incised on either side of the median line. These incisions are made about 1.5 cm. in depth and extend almost the entire length of the posterior surface of the prostate. They diverge slightly from before, backwards, being about 1.8 cm. distant behind and 1.5 cm. distant in front.

Young explains that the advantage of deep incisions lies in the ease with which the finger can be made to find the line of separation between the hypertrophied lobes and the urethral wall. Deep incisions likewise permit the operator easily to find the line of cleavage between the capsule and the posterior and lateral surfaces of the hypertrophied lobes. In fact, Young advises that the enucleation be begun on the posterior surface and that this surface and the lateral surface be separated from the capsule by means of a blunt dissector before an attempt is made to free the remaining surfaces.

It is well, in this connection to recall, that the posterior lobe tubules of the prostate rarely if ever share in the hypertrophic process, but become compressed as the result of the growth of the hypertrophic lateral lobes. Thus they come to contribute to the formation of the false capsule, hence the deep incision necessary to reach the line of cleavage.

Having freed the posterior and lateral surfaces of the prostate on either side, the urethral surface is freed in a similiar manner, care being taken to inflict the minimal amount of injury to the urethral walls.

Firm adhesions will be found binding the apex of each lateral lobe to the capsule and it is necessary to use the scissors at this point. After freeing the apices of the lateral lobes, the enucleation is completed by carrying the finger along the anterior surface of each lobe until the bladder surface is reached, which alone remains to be separated. The enucleation is facilitated by exerting traction on the lobes, a special forceps being provided for this purpose.

As a rule, the hypertrophied lateral lobes can be removed without tearing into either the urethral or the vesical mucosa, but should this occur, it is not of great importance and it is not necessary to make any attempt to repair the damage.

No one method of enucleation is applicable to all cases, and instead of the orderly sequence of events just described, the removal of an adherent fibrous prostate oftentimes proves a difficult task and one in which morcellement must be practised, removing the organ piecemeal. In fact, we frequently fall far short of the ideal in these exceedingly difficult cases in which it becomes necessary at times, not only to destroy the ejaculatory ducts but a portion of the urethra as well, in our efforts to remove the obstructing organ.

In the ordinary case of benign prostatic hypertrophy, however, the procedure just described sufficies completely to remove the obstruction at the vesical outlet without endangering the integrity of the ejaculatory ducts.

The presence of isolated median lobe enlargements or median bar formations at the posterior lip of the vesical outlet necessitates additional dissection. Their removal is best accomplished by delivering them into one or other of the cavities left after removal of the lateral lobes. Whether the remaining obstruction is in the nature of a lobe or median bar its relation to the ejaculatory ducts is exactly the same; both lie beneath the floor of the urethra primarily, and in front of the ducts.

The enlarged median lobe can be delivered more easily into one of the lateral cavities, the delivery being accomplished by means of the tractor blades or with the finger pressing on the lobe through the walls of the cavity on the opposite side.

Young advises that the tractor be removed from the bladder before attempting the removal of a transverse or median bar. The latter is picked up with a sharp hook through one of the lateral cavities; it is then dissected free from the ejaculatory ducts behind and the urethra in front, either by blunt dissection or with the aid of the scissors. After the removal of the bar, the finger can be passed through the space whence it came, from one lateral cavity to the other.

Rarely is the urethral wall intact at the conclusion of a perineal prostatectomy, and advantage may be taken of the rents in the mucous membrane for digital exploration of the interior of the bladder.

Most important in this connection is the condition of the vesical outlet; are there any remaining lobules of prostatic tissue—is the sphincteric area infiltrated with a constricting ring of fibrous tissue which demands dilatation—does the bladder contain calculi?

These are the important factors which must be searched for and if found, corrected, before the operation can be said to be completed.

Calculi may be removed through an incision on the lateral wall of the urethra. This incision may be carried through the sphincteric area if the calculi are too large to be delivered through the vesical outlet. These tissues must be brought together with sutures after the removal of the stones. We have never had occasion to remove large stones from the bladder during the course of a perineal prostatectomy although Young states that a stone five cm. in diameter can be removed in the manner just described.

In our judgment the presence of stones, especially large ones, complicating hypertrophy of the prostate, is a very definite indication for the suprapubic operation; we should certainly hesitate before enlarging an urethral incision through the sphincteric area

into the bladder, for the purpose of removing a large stone, on account of the danger of permanent incontinence of urine following this procedure.

Wide dilatation of the internal vesical sphincter, while not attended with the same danger of incontinence as division of the muscle, is nevertheless, dangerous. There can be, it seems to us, no question of the superiority of the suprapubic operation when stones are a complicating factor.

It now remains properly to drain and to close the wound. For the former purpose a catheter of large calibre is used. Through this the bladder is thoroughly cleansed of blood clots and debris by irrigations of hot saline solution.

The lateral cavities are packed with strips of gauze, the ends of which are brought out along with the drainage tube.

Young advises as a final step in the operation, careful digital exploration of the rectum in search for injuries which, if present, must be sutured.

The levator ani muscles are drawn together in front of the rectum by a single suture of catgut.

The skin incision is closed with interrupted sutures leaving a space near the apex through which the gauze packing and the drainage tube emerge.

After-Treatment.—The general systemic treatment for the purpose of restoring the normal, function of the vital organs, combating shock, etc., does not differ from that usually employed. Hypodermoclysis is given routinely.

Before the patient is removed to his room the drainage tube must be anchored in the proper position and the bladder irrigated with hot saline solution to remove any blood clots that may have accumulated. Subsequent irrigations of the bladder are unnecessary unless the tube becomes obstructed. In this event the obstruction, which is usually caused by a blood clot, should be removed by flushing the tube with saline solution.

In the absence of bleeding the gauze packing is removed early, within twenty-four hours after operation, and is not renewed. The tube is retained until the following day when, in the absence of bleeding, it also is removed.

The subsequent treatment is quite the same as that following the suprapubic operation. The patient should be gotten up on a chair within forty-eight hours after operation, if conditions warrant it. Instru-

mentation to prevent stricture formation of the urethra is unnecessary. A complicating cystitis may necessitate local treatment.

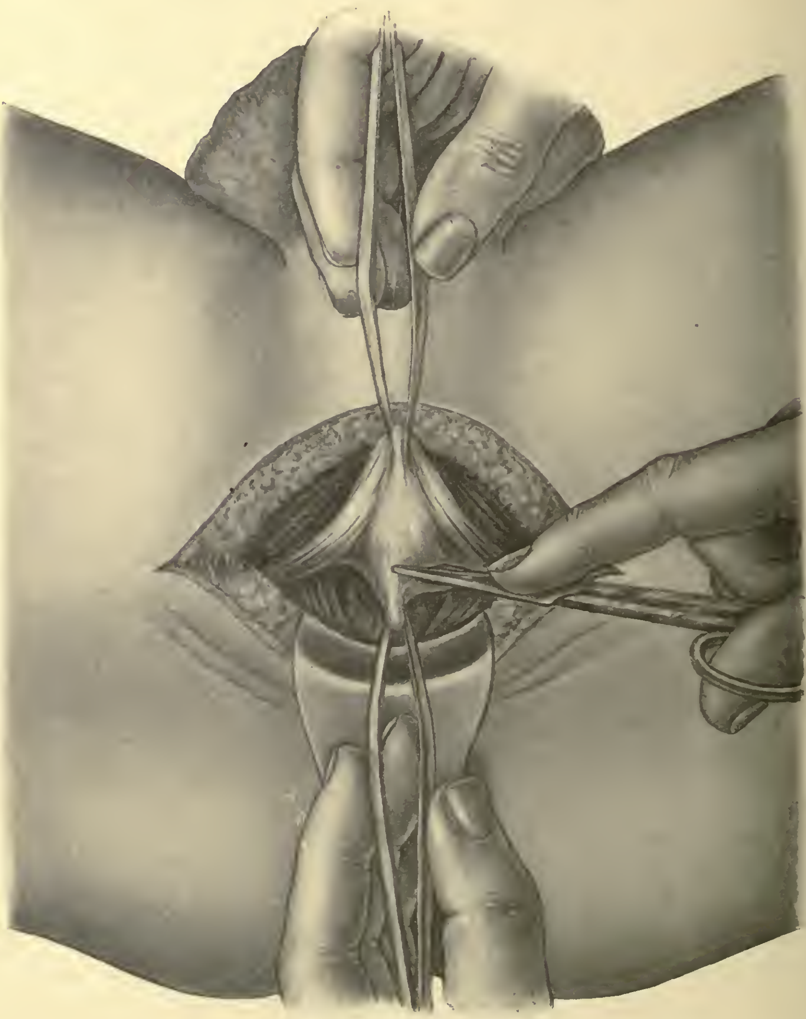

Fig. 124.—Perineal Prostatectomy.—(*Proust.*)
After dividing the skin, and separating the insertion of the sphincter ani from the perineal centre (which is raised by forceps in the right hand of an assistant), the recto-urethral muscle is exposed, and is now being divided with scissors, close to the membranous urethra.

Perineal Prostatectomy. Technique of Proust.—Perineal prostatectomy as practised by Proust requires a special operating table, and special retractors. The patient is placed in the "inverse lithotomy position," so that the perineum is in the horizontal plane, its surface

looking upward. To secure this the patient's lumbar spine and sacrum are placed upon an inclined plane of forty-five degrees, and his legs are held by special stirrups high in the air, with the thighs fully flexed and horizontal. By means of this position it is claimed that a very much

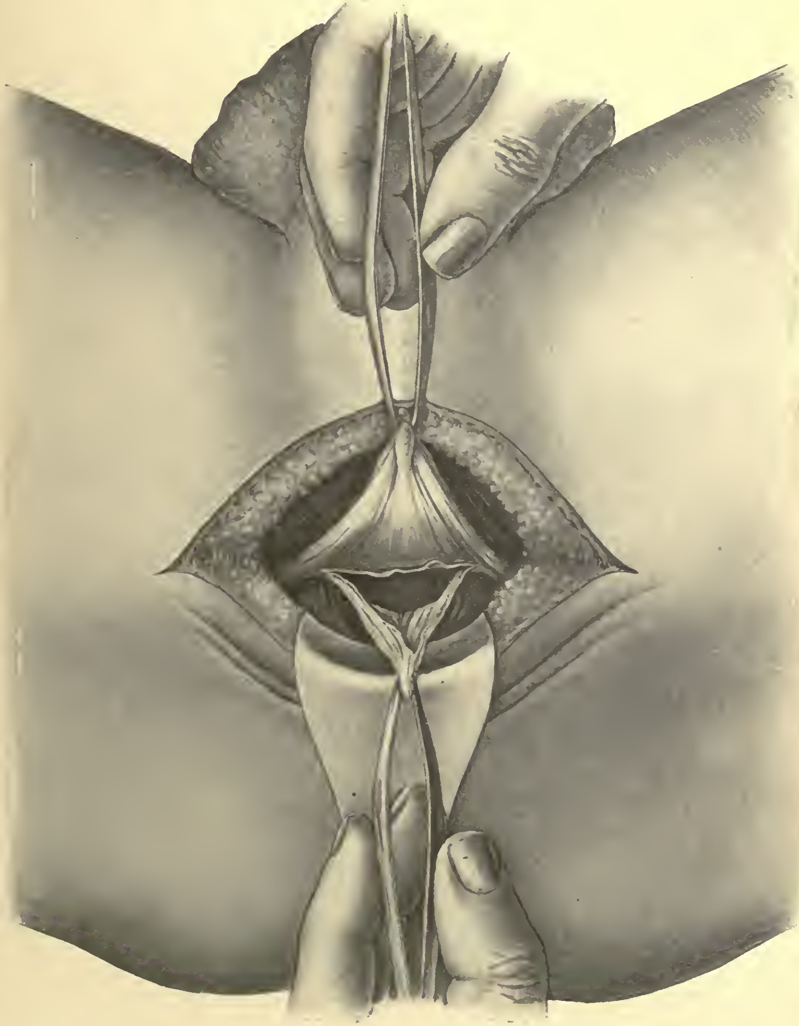

FIG. 125.—PERINEAL PROSTATECTOMY.—(*Proust.*)

The recto-urethral muscle has been divided, allowing the rectum to fall away from the anterior structures, and opening the "*espace décollable rétroprostatique.*"

larger operative field in the perineum is exposed, since, after division of the recto-urethral muscle, and opening of the aponeurosis of Denonvilliers, as will be presently described, the rectum and anus can be drawn

upward against the coccyx and the lower bones of the sacrum, making a yawning wound. For this purpose a self-retaining retractor is employed, and the aid of an assistant may be dispensed with.

Fig. 126.—Perineal Prostatectomy.—(*Proust.*)
The two index fingers of the operator are introduced between the two layers of the aponeurosis of Denonvilliers, and enlarge the "*espace décollable rétroprostatique.*"

With the patient in the position above described, his bladder being empty, and a metal guide or catheter in the urethra being held close beneath the pubic arch, so as to draw the bulb of the urethra well up out of the operative field, a transverse incision is made in front of the

anus, with its convexity forwards, from one ischiac tuberosity to the other. The attachment of the external sphincter ani to the perineal centre is then divided, and the dissection continued posterior to the

FIG. 127.—PERINEAL PROSTATECTOMY.—(*Proust.*)

The sheath of the prostate (the anterior layer of the aponeurosis of Denonvilliers) has been opened, and the surgeon's finger now detaches the sheath from the prostate by blunt dissection. The prostatic tractor sometimes employed by Proust is not shown in this illustration.

transverse perineal muscles. By drawing the anus backward, that is, towards the operator, the recto-urethral muscle is put upon the stretch.

This is a somewhat indefinite structure which consists of muscular and fibrous tissue passing from between the layers of the triangular ligament backwards to the rectum, by their insertion into which is produced the acute flexure of this canal just within the anus.

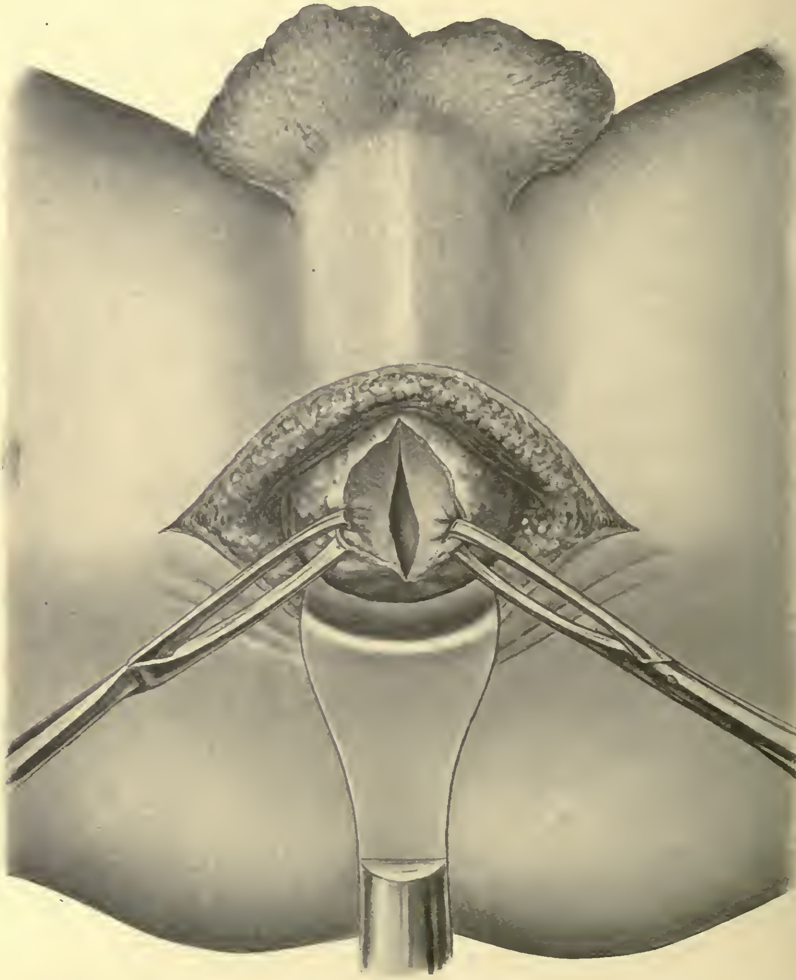

FIG. 128.—PERINEAL PROSTATECTOMY.—(*Proust.*)
Hemisection of the prostate along the floor of the urethra.

The recto-urethral muscle must next be divided. This is done with a pair of scissors, snipping through these fibres close to the membranous urethra. If great care is not exercised to keep close to the membranous urethra, but without opening it, the dissection will be made below the posterior layer of the aponeurosis of Denonvilliers,

between it and the rectum, instead of between the two layers of this structure, where is found the "*espace décollable rétroprostatique.*"

As soon as the recto-urethral muscle has been divided in the required place, the rectum will fall away from the anterior structures, and the

FIG. 129.—PERINEAL PROSTATECTOMY.—(*Proust.*)
Each lobe of the prostate in turn is dissected free from the sides of the prostatic urethra.

two layers of the aponeurosis of Denonvilliers may be readily separated with the two index fingers. The rectum will now appear like a loop of intestine floating free in the peritoneal cavity, being covered by the posterior layer of this aponeurosis, while the anterior layer still conceals the prostate and seminal vesicles from view. It is to be recalled that

the aponeurosis of Denonvilliers is really an obliterated sac of peritoneum.

When the *"espace décollable rétroprostatique"* is thus widely opened, the special retractor is inserted, and screwed up so as to hold the rectum and anus against the sacrum and coccyx.

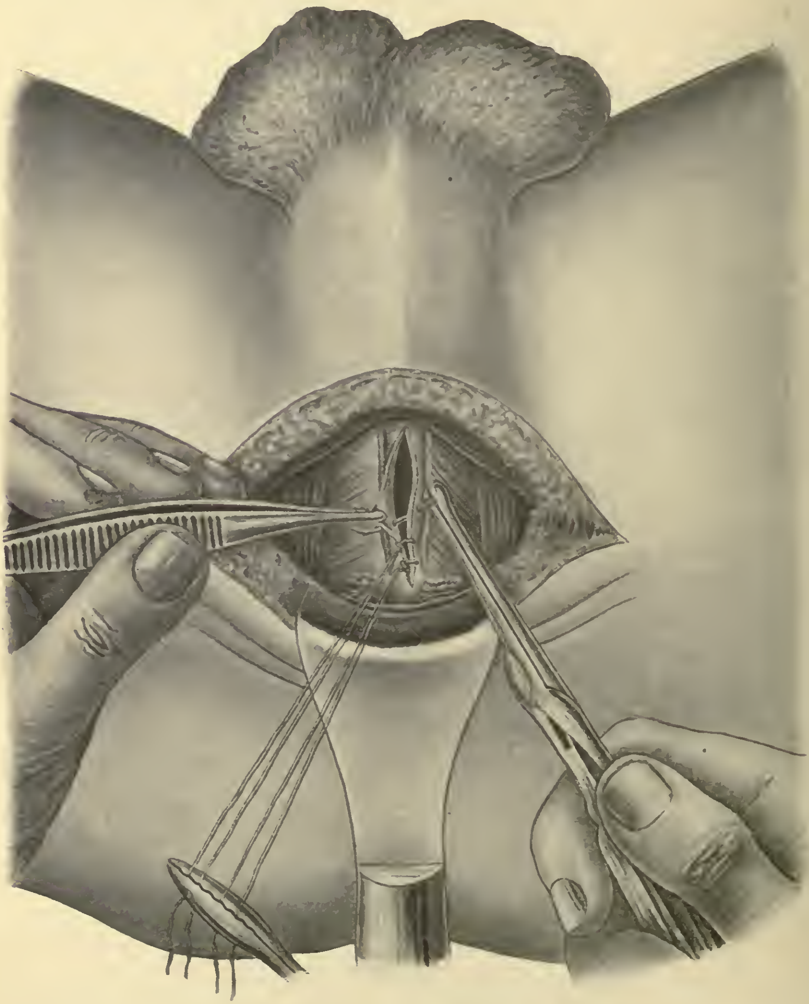

Fig. 130.—Perineal Prostatectomy.—(*Proust.*)
The ejaculatory ducts have been ligated, and the urethra is now being sutured.

Beyond the anterior layer of the aponeurosis of Denonvilliers the prostate can now be indistinctly felt, floating away as soon as it is touched. Proust now opens the urethra, at the apex of the prostate, posterior to the triangular ligament, not between its layers; and after withdrawing the guide, inserts into the bladder through the urethral

incision a special tractor—dePezzer's—which is very similar to that employed by Young.

The prostate being thus steadied by spreading the blades of this tractor over its vesical surface, the sheath of the prostate (the anterior layer of the aponeurosis of Denonvilliers) is to be opened, with scissors,

FIG. 131.—SKIN INCISIONS FOR PERINEAL PROSTATECTOMY.

parallel to the urethra. The finger of the surgeon is then inserted between this layer of fascia and the capsule of the prostate, which is thus exposed on its rectal aspect; and the surgeon proceeds to detach the prostate from its sheath by the finger. He detaches it first along the side of one lateral lobe, then below, and from the vesical aspect, and

finally in front, above, and close to the pubis. This enucleation should be done deliberately, and with the most painstaking thoroughness.

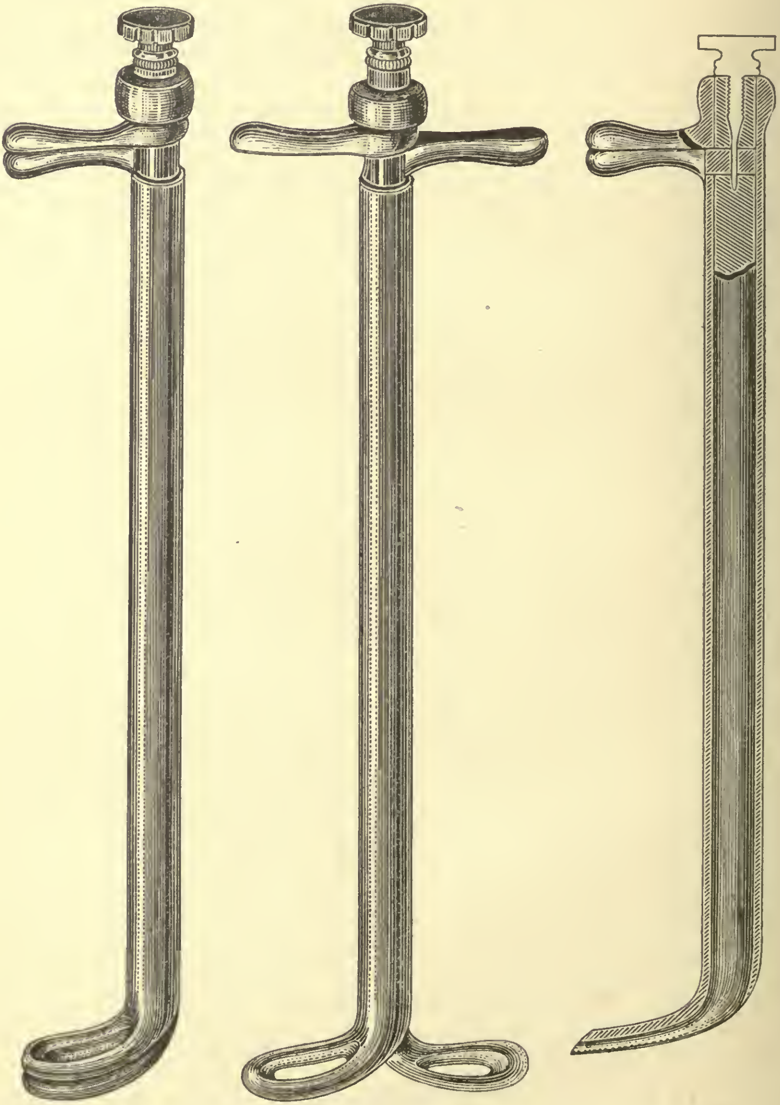

FIG. 132.—YOUNG'S PROSTATIC TRACTOR.

Proust says that time apparently lost at this stage of the operation will at a later stage be found to accelerate matters considerably. When the prostate is thus freed of all its attachments, except those to the

urethra, and to the ejaculatory ducts, the operation may proceed, but not before. The prostatic tractor is then removed.

The wound in the urethra is now enlarged. This is accomplished by splitting its floor from the apex of the prostate to but not

FIG. 133.—Young's prostatic tractor in place, seen from within the bladder.

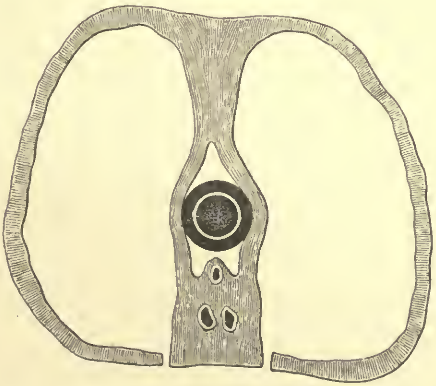

FIG. 134.—PERINEAL PROSTATECTOMY.—(*Young.*)

Diagram to show parts removed in operating according to Young's technique: in the centre a catheter is seen in the prostatic urethra; below are shown the ejaculatory ducts and uterus masculinus in the posterior commissure of the prostate.

into the neck of the bladder. This cut hemisects the prostate as well; and each lobe in turn is then dissected off the lateral and upper aspects of the prostatic urethra by means of scissors, the index finger of the left hand being placed on the mucous surface of the prostatic urethra,

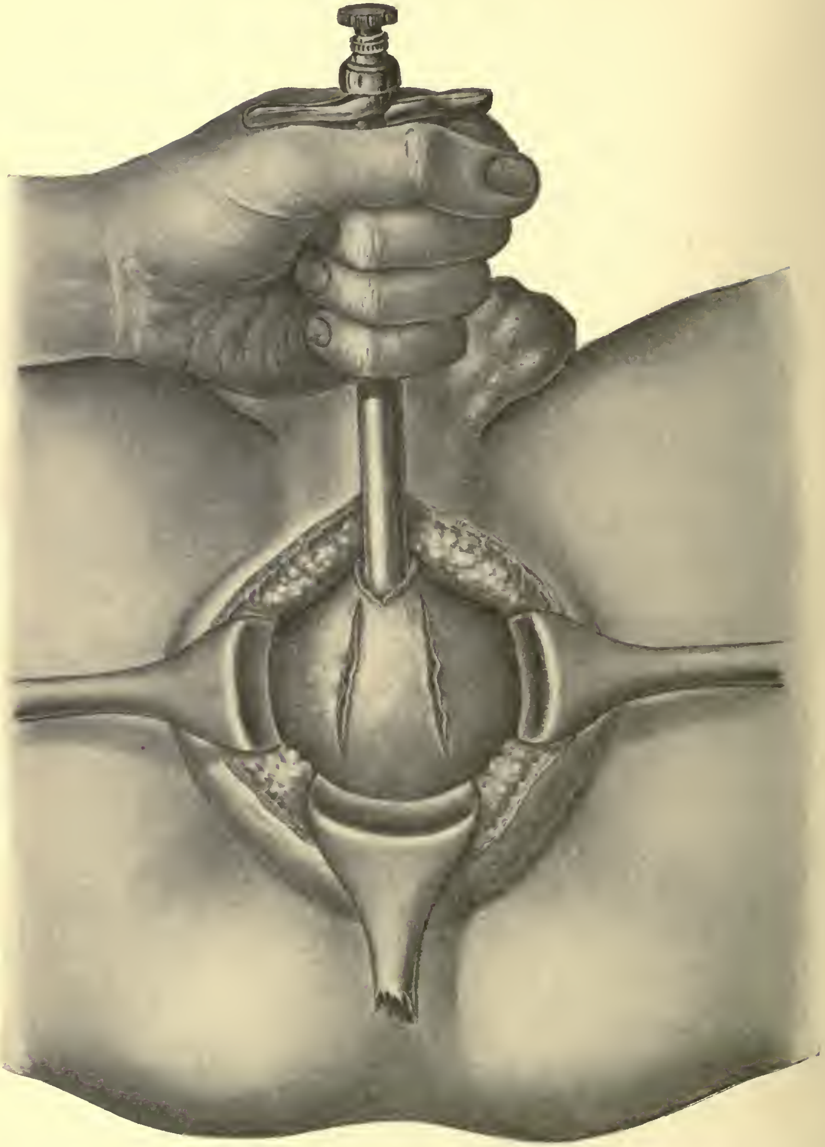

FIG. 135.—PERINEAL PROSTATECTOMY.—(*Young.*)

Incisions on each side of posterior commissure down to the prostatic urethra. The prostatic tractor has been introduced through the opening in the membranous urethra, and draws the prostate well down into the perineum.

if necessary, as a guide. Proust ligates the ejaculatory ducts, thinking that by this means orchitis is less apt to occur. He removes each lateral lobe entire, advising against morcellement, which he considers neces-

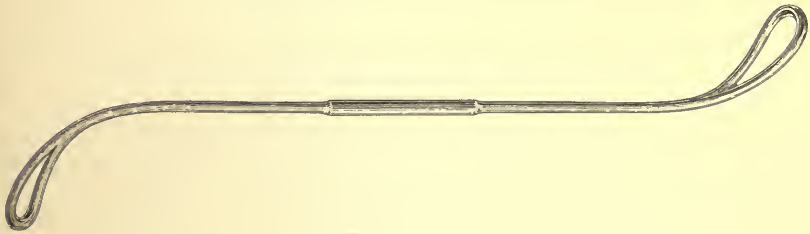

FIG. 136.
Ferguson's prostatic depressor.

sary only when the gland is extremely friable and comes away in pieces of its own accord. He follows Albarran in the practice of resecting the

FIG. 137.
Syms's prostatic tractor, collapsed, and ready for introduction through an opening in the membranous urethra.

floor of the prostatic urethra when this part of the canal is unduly dilated.

When an intravesical projection, more or less pedunculated, is

FIG. 138.
Syms's prostatic tractor, distended, as it is after its introduction into the bladder.

present, he delivers this through the prostatic urethra, and accomplishes its removal just as though working through a suprapubic wound; or if the pedicle is too short or too broad to allow of its delivery in this manner, he works up from the lower surface of the bladder, and enucleates the mass without opening the vesical mucous membrane.

The operation is completed by passing a rubber tube or catheter through the penis into the bladder, and another catheter to the bladder

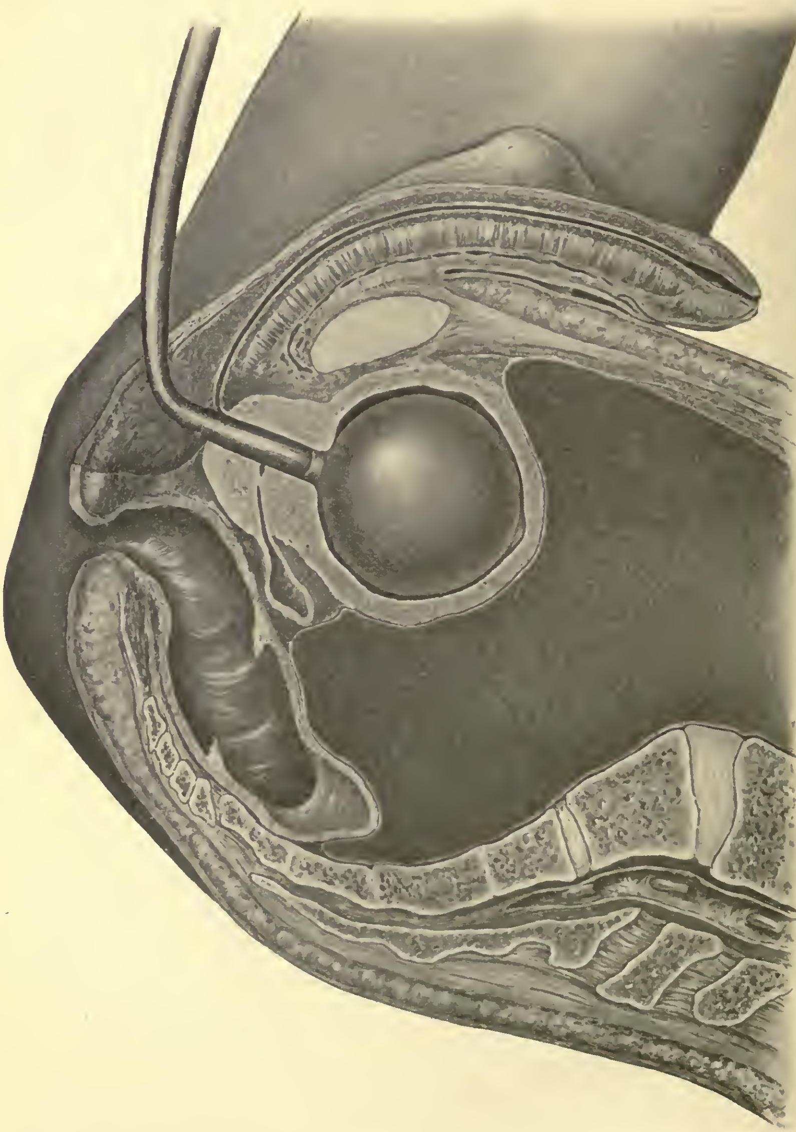

Fig. 139.—Syms's Prostatic Tractor in Use.

Its bulbous extremity has been expanded within the bladder, and by traction on the stem the prostate is drawn down into the perineum.

through the perineal wound. Ordinarily the calibre of the prostatic urethra is such that it will easily accommodate both these tubes; should

such, however, not be the case, that through the penile urethra is to be omitted.

The prostatic urethra is sutured around the perineal tube with interrupted stitches of catgut, except where the tube emerges, at the triangular ligament. Three wicks of gauze are required to drain the perineal wound, which is partially closed by a few buried sutures, and by two deep (not buried) sutures at each of its angles. A firm gauze

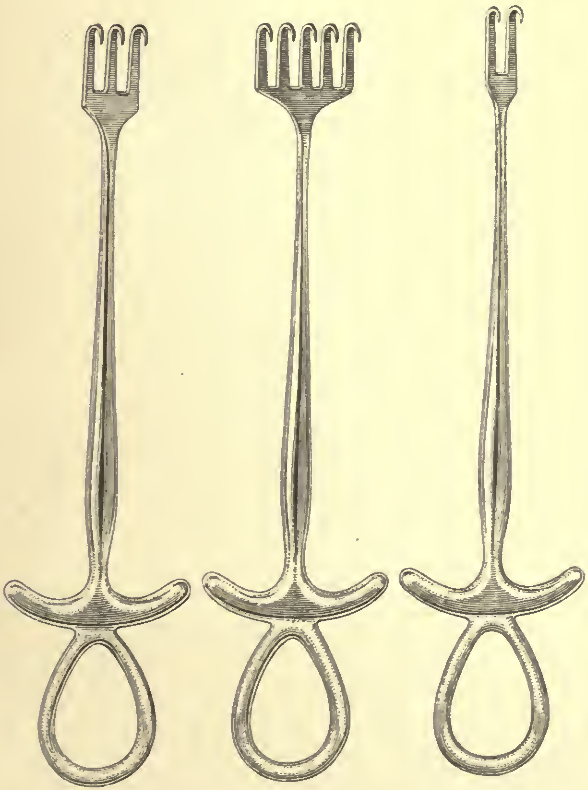

FIG. 140.—MURPHY'S HOOKS, FOR USE IN PERINEAL PROSTATECTOMY.

pad is placed between the coccyx and the anus, so as to hold the rectum forward, its normal anterior support having been destroyed by the division of the recto-urethral muscle. The usual superficial dressings are applied; and the patient when returned to bed is so arranged that the bladder shall be higher than the outer end of the perineal tube. This is best accomplished by using a perforated mattress, and having the tube drain into a urinal beneath the bed. If this plan cannot be carried out, Proust advises placing a board across the bed beneath the

mattress, where the patient's buttocks will rest upon it, and thus be effectually prevented from making a depression in the bed lower than the outer end of the tube, which would then have to drain up-hill. As a substitute for this plan, the patient's buttocks may be made to rest

FIG. 141.—SKIN INCISIONS FOR PERINEAL PROSTATECTOMY.
The dotted line shows Dittel's incision. The unbroken line shows the incision employed in the technique illustrated in Plates.

upon a firm pad or pillow, placed above the mattress. Some such device Proust insists is essential to ensure the proper drainage of the bladder. The penile catheter is plugged, and all urine passes by way of the perineal tube.

In the after-treatment, the bowels are kept locked for eight days; for the first week the bladder is irrigated twice daily by injecting small quantities of fluid through the penile catheter, and allowing it to escape by the perineal tube. The dressing is first removed at the end of forty-eight hours, and subsequently renewed once every day. He removes the perineal tube on the eighth day, and lets the urine then drain by the penile catheter. This should be changed frequently to prevent concretions forming on it; and in doing so the upper wall of the urethra should be sedulously followed. Proust employs catheters of the general form of Mercier's, but having an extra eyelet on the convexity of the angle; before withdrawing one he passes a straight flexible guide along its interior until the guide projects through this extra eyelet into the bladder; the catheter is then withdrawn over the guide, which remains in the urethra, and serves as a conductor for the insertion of the new catheter.

He prefers to keep the penile catheter in place, changing it frequently, for from three to five weeks, that is, until the perineal wound has closed. Complete healing of the perineal wound is generally assured in from five to seven weeks.

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